A SKETCH OF THE HISTORY OF REFLEX ACTION.

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I.

BEGINNINGS AND DEVELOPMENT TO THE TIME OF CHARLES BELL.

The suggestions followed out in this chapter were obtained chiefly from notes made from the original sources in several of the libraries of Europe by Dr. G. Stanley Hall about the year 1880. At that time Dr. Hall was working upon reflex action in Ludwig's laboratory in Leipzig, and his object in going through the literature was that he might write a history of the subject in connection with his own work. In 1880 there was no history of reflex action later than Johann Wilhelm Arnold's[1] which appeared in 1842; and rapid progress since that time had rendered this inadequate for the needs of physiologists and doctors for whom it was written. But, as it often happens in science, when a need is felt, that several persons take up the work independently, Eckhard had been for a number of years collecting data for a history of this very subject. His admirable book[2] was published in 1881,

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[1] Johann Wilhelm Arnold. Die Lehre von der Reflex-function für Physiologen und Aerzte. Heidelberg, 1842.
[2] C. Eckhard. Geschichte der Entwickelung der Lehre von den Reflexerscheinungen. Beiträge zur Anat. und Physiol. Vol. 9. Giessen, 1881.

and seemed to meet the demand so fully that Dr. Hall laid his work aside for the time.

The two works were somewhat different in scope. With the one, interest centers about the facts of nerve physiology, with the other attention is directed to the psychological development which underlies the appreciation of facts and recognizes the value of experiment. For example, Eckhard says, "No doubt many true reflexes are included among the phenomena of the so called '*sympathies.*' To follow these out, however, has no interest for the experimental physiology of the nervous system."[1] This is in striking contrast to the way Dr. Hall has treated the subject in his introductory chapter,[2] where he brings out the underlying psychic relation between the quality of mind which produced the doctrine of sympathies of the older physiologists and that which gave rise to modern views of reflex action. It is there shown how the soul was at first thought to be able to produce sympathy between different parts of the body directly, without the mediation of any corporeal mechanism whatever. Later, when the arteries were supposed to contain the soul or "ether," these became indirectly the means of sympathy, and so on, until the arteries were proved to carry blood, and experimental evidence began to point to the nerves. Thus the reader is lead to see how the mind, from rejoicing in fanciful explanations of things, comes step by step to appreciate nature as it is, and to prefer plain reality to its own imaginings.

Endeavoring to retain this point of view we may take up the line of historical development at the time when the importance of the nervous system begins to be recognized.

With the revival of interest in anatomy under Vesalius (1514—1564), and its further progress under Dulaurens (1550—1609), by the close of the sixteenth century the nervous system had been fairly well distinguished from the other

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[1] Beiträge, op. cit., p. 33.
[2] See this JOURNAL, Vol. III, No. 1. Introductory chapter to this subject.

tissues, and to it, in a theoretical way, had been ascribed certain functions of the soul. In some cases "sympathy" was said to be due to the connection of parts by nerves. For example, Dulaurens writing in 1595 ascribes the "sympathy" between the mammæ and the uterus in part to the "intercostal nerve" and in part to the azygous vein. It is not, however, until Descartes that we have the tangible beginning of what is to-day the science of reflex action.

The general neurological conceptions of Descartes may best be given in his own words :

"Although the soul is united with the whole body, its principal functions are, nevertheless, performed in the brain; it is here that it not only understands and imagines, but also feels; and this is effected by the intermediation of the nerves, which extend like delicate threads from the brain to all parts of the body, to which they are attached; so that we can hardly touch any part of the body without setting the extremity of some nerve in motion. This motion passes through the nerves to that part of the brain which is the common sensorium, as I have sufficiently explained in my Treatise on Dioptrics; and the movements which thus travel along the nerves to that part of the brain with which the soul is closely united, awaken by reason of their diverse characters different thoughts in the mind."[1]

Thus Descartes makes the brain pre-eminently the organ of the soul. But his views on this point were far ahead of his time, and he was obliged to contend against a strong current of opinions like those of Plato, who taught that the soul thought in the brain, felt passion in the heart, and desire in the liver. In these controversies Descartes' dissections stood him in good stead, as the following will show.

"The opinion of those who think that the soul receives its passions in the heart, is of no value; for it is founded only upon the fact that the passions cause a change to be felt in that organ; and it is easy to perceive that this change is felt, as if it were in the heart, only by the intermediation of a little nerve which descends from the brain to it; just as

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[1] Œuvres de Descartes, publiées par Victor Cousin, Paris, 1824. Les principes de la philosophie. § 189, Vol. III, p. 500.

pain is felt, as if it were in the foot, by the intermediation of
the nerves of the foot; and the stars are seen as if they were
in the heavens, by the intermediation of their light and of the
optic nerves. So that it is no more necessary for the soul to
exert its functions immediately in the heart, to feel its pas-
sions there, than it is necessary that it should be in the
heavens to see the stars there."[1]

We see from the above that Descartes had a clear idea of
the sensory action of nerves. His conception of motor nerves
is no less clear, although here the general ideas of his time
cause a conspicuous bias. He says: "All the movements
of the limbs, moreover, depend on the muscles; and finally
we know that all these movements of the muscles, as well as
all the senses, depend on the nerves, which are like little
threads or tubes, all come from the brain, and like it, contain
a very subtle air or wind, called animal spirits."

This leads us to Descartes' notion of the reflex process,
which in essentials is as good as any we have to-day, viz,
that a sensory impulse is carried to the brain and there may
be, unconsciously or even in spite of the will, reflected,
"*réfléchie*,"[2] to motor nerves and so cause a co-ordinated con-
traction of the muscles.

That "reflected" movements are effected by a corporeal
machine, which may act in direct opposition to the volition
of the soul, Descartes proves in the following suggestive
language:

"And in addition to the different feelings excited in the
soul by these different motions of the brain, the animal
spirits, without the intervention of the soul, may take their
course toward certain muscles, rather than toward others,
and thus move the limbs, which I shall prove by an example.
If some one moves his hand rapidly toward our eyes, as if to
strike us, although we know that he is a friend, that he does
it only in jest, and that he will be very careful to do us no
harm, nevertheless it is difficult to refrain from closing them.
And this shows that it is not by the agency of the soul that
the eyes close, since this action is contrary to that volition,

[1] Les passions de l'ame, article XXXIII, op. cit., Vol. IV.
[2] Les passions de l'ame, article XXXVI, op. cit., Vol. IV.

which is the only, or at least the chief, function of the soul ; but it is because the *mechanism of our body* is so constructed that the motion of the hand toward our eyes excites another movement in our brain, and this sends the animal spirits into those muscles which cause the eyelids to close."[1]

But Descartes goes even further, and outlines the great field of involuntary action in general, including actions which become reflex by habit and education. To quote again, he says :

" Yet I will say further that it appears to me a very remarkable circumstance that no movement can take place, either in the bodies of animals, or even in our own, if these bodies have not in themselves all the organs and instruments by means of which the very same movements could be accomplished in a machine. So that, even in us, the spirit, or the soul, does not directly move the limbs, but only determines the course of that very subtle liquid called animal spirits, which, flowing continually from the heart through the brain into the muscles, causes all the movements of our limbs, and often may effect many different motions, one as easily as the other. And the mind does not even always determine these movements, for among them there are many which do not depend upon the mind at all, such as the beating of the heart, the digestion of food, the nutrition, the respiration, of those who sleep; and, even in those who are awake, walking, singing, and other similar actions, when they are performed without the mind thinking about them. And, when one who falls from a height throws his hands forward to save his head, it is through no process of reasoning that he performs this action ; it does not depend upon his mind, but takes place merely because his senses being affected by the present danger, some change arises in his brain which determines the animal spirits to pass thence into the nerves, in such a manner as is required to produce this motion, in the same way as in a machine, and without the mind being able to hinder it."[2]

It is suggestive to see how instantly the mind, set free from

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[1] Les passions de l' ame, article XIII, op. cit., Vol. IV.
[2] Op. cit., Objections et Réponses, Vol. II, p. 52.

the perplexing trrationalfty ofsan immaterial principle acting lawlessly in the body, seeks the lawful mechanical explanation of the phenomena of life. It is suggestive, too, that mechanism is so readily found by him who seeks in the right spirit. So from the thought of Descartes sprang, full formed, the principle of mechanical physiology, and with it that of reflex action.

It would hardly be fair to ask of Descartes now-a-days proofs for all his statements. Some of his proofs are as good as any we have to-day; others are as fanciful as his reason for placing the soul in connection with the pineal gland. What to us are shadows were solidest realities to the men of his time. The soul as a separate entity was as real to Descartes as his own body; and "animal spirits," as a "subtle liquid," was as familiar to all the philosophers of that time as ordinary blood is to us to-day.

It is a great descent from the clear views of Descartes to the obscure ideas of his contemporaries and even of those who follow him. But there are compensations; for we shall exchange in a measure the highways of philosophy for the by-paths of experiment.

Reflex phenomena begin to strike the attention of a number of observers independently. Swammerdam (1637—1680), notices the reflex movements of sleeping animals and men, when the skin is gently stimulated. Francesco Redi (1626—1694), in Pisa, in connection with his work on the venom of serpents, has his attention called to the movements of animals after decapitation. Boyle (1626—1669), in England, describes the same phenomena in decapitated serpents as follows: "The body of vipers may be sometimes, two or three days after the skin, heart, and all the entrails are separated from it, seen to move in a twining or wriggling manner, nay, may appear to be manifestly sensible of punctures, being put into a fresh and vivid motion, when it lay still before, upon the being pricked especially on the spine or marrow, with a pin or needle."[1] It is difficult to conceive ho Descartes could have refrained from putting his notions

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[1] C. Eckhard, op. cit., p. 38.

of reflex action to the test of experiment by vivisection. Had he done so, however, he must have discovered that the spinal cord, as well as the brain, could function as a "reflection" center. But here Descartes fell short, and now it appears that animals without the brain, the drive wheel of Descartes' whole machine, retain the power of responding to stimuli by reflected contractions. This brings the question to the point, viz: does this power have its seat in the body generally or in the spinal cord? As decapitation had demonstrated that it did not reside wholly in the brain, so one crucial experiment, the removal of the spinal marrow, would have demonstrated that it *is not present* in the body in general. But instead of making this experiment, the learned doctors turned to speculation and controversy as was their wont before Bacon tried to teach them a better way of using their time. A century elapses before the simple experiment is made, and meanwhile, the fight goes on about the soul, its location in the body, its connection and relation to it, its divisibility, etc., etc.; and added to this was discussed the question, whether "*sympathy*" depended on union of nerves in the spinal cord, their union at the periphery, or on blood vessels and continuity of tissues.

To Thomas Willis (1622—1675) is generally ascribed the origination of the notion of peripheral nerve anastomoses.[1] If this is true, Willis required his good work in brain anatomy to atone for such a mistake. And still, Willis wrote his "Cerebri Anatome" in 1664. In 1628 Harvey published his work on the circulation of the blood. And just before Willis wrote (1661), Malpighi supplied the one remaining link in the evidence for Harvey's doctrine by discovering the capillaries. It was a time when everything possible in the body must circulate, and in order for the "subtle liquid" within the nerves to do this, peripheral connections must exist between efferent and afferent nerves as between arteries and veins.

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[1] " Dr. Willis, who has given a more accurate description of the brain and nerves than any anatomist before him, endeavored, first, to explain the various instances of sympathy between the parts of the body, from the connection or communication of their nerves. This doctrine was afterwards further illustrated by Vieussens, and has been embraced by most of the later writers." Works of Robert Whytt, Edinburg, 1768, oot-note, p. 50l

The pressure of theory was, in short, strong enough to make some men see what did not exist. And Willis, "a lucky dissector, but a hair-splitting theorist,"[1] seems to have been the sort of man to see in this way. As Ridley, writing in 1695, quaintly put it: "I am apt to think that that learned person [Willis] too soon fell in love with his first thoughts, the ordinary reason of either one's seeing false, or not far enough."[2]

Willis was to some extent a student of Descartes, to whose influence he probably owed his bent toward the study of the nervous system. For things which Descartes treated in general terms, Willis naturally sought to discover special mechanisms. Thus, he says, if the brain secretes the "spiritus animalis," it, in turn, must obtain the nourishment which enables it to do so from the blood. This led Willis to study the blood supply of the brain, and the memory of his work in this direction is fitly perpetuated in the arterial ring which bears his name, the circle of Willis. He further correctly describes how the blood vessels of the brain distribute themselves and finally penetrate the surface in order to convey to the small nerves therein a delicate liquor which serves for the production of the spiritus animalis. The flow of the spiritus is determined by the convolutions, and each of these consists of two distinct substances, the gray and the white. Willis further considers that the actual secretion of the spiritus animalis must chiefly take place in the gray matter for the very good reason that the white resembles the matter of the nerves and spinal cord and to it should be ascribed the same function, viz.: the storage and distribution of the spiritus animalis.[3] In the matter of reflex action, Willis follows Descartes in the use of the term, "reflexa" and in general thought, likening the reflex process to that of reflected sound in echo, but differs from him in making the periphery as well as the brain the seat of the reflex process.

After Willis, Astruc of Montpelier (1684—1766), carried

Sprengel. Geschichte der Arzneykunde, 1827, Vol. IV, p. 201.
[2] Ridley. Anatomy of the Brain, London, 1695, p. 160.
[3] Willis, Cerebri Anatome, Amst., 1664, pp. 46, 49, 50.

out the suggestions of Descartes in a most rigidly mechanical way. He grouped sympathies, however, in the old style into several classes according as he supposed them to be explained by anastomoses of veins, continuity of tissue, anatomical or physiological resemblance, or by the nervous system. These latter, including respiration, deglutition, defecation, parturition, hysteria, teething-convulsions, and winking, are true reflexes. The brain he thought to be formed of tubes closely pressed together and often interrupted by columns of tendinous fibers. Against these columns the nerve tubes opened and upon them the spiritus animalis beat, the flux and reflux causing sensation and motion. As with light, angles of incidence and reflection are equal, so that a sensation produced by a concussion of animal spirits against the fibrous columns is reflected and causes motion in those nerve tubes which happen to be placed exactly in the line of reflection. The force with which the animal spirits impinge, however, may be so great as to cause motion in the nerve tubes on the other side of a column, thus producing an irradiation of reflected motion which might change the angle of reflection one hundred and eighty degrees.[1]

This work of Astruc was published in 1743. In 1751 appeared the celebrated essay of Robert Whytt (1714—1766), upon the " Vital and other Involuntary Motions of Animals." Section 1, of this essay opens as follows :

" A certain power or influence lodged in the brain, spinal marrow, and nerves, is either the immediate cause of the contraction of the muscles of animals, or, at least, necessary to it.

"The truth of this appears from the convulsive motions and palsies affecting the muscles when the *medulla cerebri*, *medulla oblongata* and *spinalis*, are pricked, or any other way irritated or compressed ; as well as from observing that animals lose the power of moving their muscles, as soon as the nerve or nerves belonging to them are strongly compressed, cut through, or otherwise destroyed."[2] " The tying or cut-

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[1] Cayrade. Recherches sur Mouvements Réflexes. Paris, 1864, p. 13. Cayrade makes Astruc the first to use the term reflex; but he has certainly overlooked the claims of Descartes and Willis in this matter.
[2] The Works of Robert Whytt, Edinburg, 1768, p. 3.

ting of blood vessels," he further adds, "has no such sudden
effect upon the muscles," citing in proof the case of a dog
which continued to use its leg, after the " crural " artery had
been tied, " until the member was almost quite dead."

At the very outset, too, Whytt breaks away from the
old overgrown ideas clustering about the term "animal
spirits," declaring his preference for the expression, " power
or influence of the nerves," and he adds : " If, in compliance
with custom, I shall at any time give it the name of *animal*
or *vital spirits*, I desire it may be understood to be without
any view of ascertaining its particular nature or manner of
acting." His division of animal movements is also good ;
but it is in a somewhat later work [1] that Whytt elaborates
his views of reflex or sympathetic action. Here he enumer-
ates many instances of normal and morbid sympathy, by which
a stimulus applied at one part causes motion in a distant part.
He especially calls attention to the fact that this may occur
where no neural connection exists between the parts except
through the brain and spinal cord. These, he justly urges,
cannot be explained on the theory of anastomoses; and
although he nowhere denies the possibility of such connec-
tions of nerves at the periphery, he brings forward a number
of facts to disprove their effectiveness.[2]

"There can be no sympathy," he argues, "between the
nerves derived from the same trunk by means of the mem-
branes that surround them ;" " because they have only an
obtuse kind of feeling," "and no moving power," "and
such connections would cause confusion in our sensations
and motions." Moreover in cases of general convul-

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[1] Observations on the Nature, Cause and Cure of those Disorders which
are commonly called Nervous, Hypochondriac or Hysteric. Edinburg,
1764. Works of Robert Whytt, Edinburg, 1768, p. 487.

[2] The best statement of Whytt's position in this matter is given in the
following foot-note, which shows also the scientific spirit of the man.

" If it should be objected, that it is as difficult to account for a sympathy
between the nerves at their origin in the brain, as in their course to the
several parts, to which they happen to be connected; I answer, that the
purpose of these observations is not to explain how the different parts
of the body can be endowed, by means of the nerves, either with a sen-
tient or a sympathetic power; but, to endeavor to trace the sympathy
of the nerves to its true source, which I take to be the brain and spinal
marrow." Whytt, op. cit., p. 512, foot-note.

sions caused by slight local irritation these connections, if admitted, must be assumed to be very extended; and still between parts close together and connected by nerves, sympathy is lacking, while it exists between distant parts. But all these arguments amount to but very little against the theory of anastomoses as compared with the fundamental and crucial experiment which Whytt brought forward. He says in describing this experiment : "When any of the muscles of the leg of a frog are pricked, most of the muscles of the legs and thighs contract, even after cutting off the head, if the spinal marrow be left entire; but when that is destroyed, although the fibres of the stimulated muscles respond with a weak tremulous motion, the neighboring muscles remain wholly at rest. There is no sympathy between the different muscles or other parts of the body as was observed while the spinal marrow was entire; from whence it seems to follow that the nerves distributed to the several parts of the body have no communication, but at their termination in the brain or spinal marrow, and that to this, perhaps, alone is owing the consent or sympathy between them."[1] The name of Dr. Hales is often coupled with this experiment, and justly so from Whytt's own account, which is as follows : "The late reverend and learned Dr. Hales informed me that having many years since tied a ligature about the neck of a frog to prevent any effusion of blood, he cut off its head, and thirty hours after observed the blood circulating freely in the web of the foot; the frog also at this time moved its body when stimulated, but that on thrusting a needle down the spinal marrow, the animal was strongly convulsed and immediately after became motionless."[2] These experiments prove that even if anastomoses existed they could not in any case mediate consent or sympathy between different parts.

Besides this, Whytt made several minor contributions to the subject. He has precedence in the discovery that, in the frog, a segment of the cord may serve to produce "consent" between the muscles to which it supplies nerves. It is Whytt, too, who seems first to have noticed that immediately

[1] Works of Robert Whytt, Edinburg, 1768, p. 520.
[2] Whytt, op. cit., p. 290.

after decapitation no sympathetic contractions could be called forth, thus anticipating the notion of inhibitory action. Finally Whytt brought the action of glands, the secretion of tears and saliva, into the category of reflex actions.

And yet with all this Whytt failed in his grasp of an important side of the subject. He repudiated the efficiency of mechanism utterly. With Whytt it is a sentient or vital principle that is behind all phenomena of life. To quote his own words: "The more probable opinion seems to be that the soul is equally present in the extremities of the nerves through the whole body as in the brain. In these it is only capable of feeling, or simple sensation ; but in this it exercises its power of reflex consciousness and reason."[1] He believed in consciousness of different degrees, and that no motion can take place in the body unattended by some degree of consciousness. "The soul is diffused through a great part of the brain and spinal marrow, and might be present at one and the same time in all parts of the body where nerves are found." Yet he distinctly rejects the doctrine of Stahl that the soul directs all the bodily functions with a full degree of rational consciousness.

" We must either allow," concludes Whytt, "that both the head and body of a frog continue to be animated for some time after they are separated from each other, or else affirm that the life, feeling, and active power of animals are merely properties of that kind of matter of which they are made. The former opinion is attended with some difficulties which arise chiefly from our own ignorance of the nature of immaterial beings." " The latter view seems to be inconsistent with all the known properties of matter. If the latter, therefore, be admitted, we not only ascribe qualities to matter which it does not possess, but presume to limit, by our own narrow capacities, the power of incorporeal natures and their manner of acting upon bodies co-existing with them."[2]

These views brought Whytt into direct collision with Haller (1708—1777). For Haller had become imbued with the idea that there was a power inherent in living muscle,

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[1] Whytt, op. cit., p. 288.
[2] Whytt, op. cit. p. 289.

"*irritability*," "*vis in situ*," which was independent of the
"*sensibility*" of nerves; and, although he takes for granted the
existence of animal spirits and even discusses at length what
manner of fluid it is, he seems to have been first to discern
inherent in living nerves a something inexplicable on then
existing theories, and to this something Haller first applied
the term, the equivalent of Whytt's "power of nerves," "*vis
nervosa*." But Haller's commendable zeal for the indepen-
dence of irritability from sensibility led him too far. In
order to prove this, he argues at great length that the pleura,
peritoneum, bones, periosteum, ligaments, cornea, and some
other tissues, are entirely without nerves and therefore
insensible. And since these are destitute of nerves, the
theory of Whytt must be amended by allowing that certain
sympathetic actions, like the secretion of the lachrymal gland
upon irritation of the cornea, must be due to simple contin-
uity of tissues. Whytt had no method then at his disposal
to demonstrate the nerves of the cornea, and even he does not
seem to have thought of destroying the brain to see if the
sympathy persisted. He attacked the matter from the other
side, however, and gives Haller an able and suggestive
answer.

"Having been lately present," he says, "at the extraction
of the crystalline lense in Mr. Sharp's method, I inquired par-
ticularly of the patient whether he felt any pain when the
cornea was first pierced with the knife? He told me he
thought the pain was much the same with what he used to
feel when the skin of his arm was cut in bleeding. It ought,
however, to be remarked, that though the skin and *cornea* have
both considerable degree of sensibility; yet, when they are
cut quickly with a very sharp instrument, there is less pain
felt than one would imagine."[1] "The tunica cornea is so far
from being insensible, as M. De Haller believes, that any one
may be soon convinced of the contrary by an experiment upon
his own eye; for when the cornea is touched with the finger
a sensible pain is felt; and it is well known that powder of
tobacco, or any acid liquor applied to the *cornea*, excites a
very acute sensation. Tho' the sclerotic coat of the eye is

[1] Whytt, op. cit , p. 263.

far from being void of feeling, yet I have found it less sensible than the cornea, by touching both not only with my finger, but with a bit of soft silk or linen."[1] Since Haller's method of demonstrating sensibility was simply to stimulate the part and notice whether the animal gave signs of pain, and since he expressly includes the conjunctiva with the cornea, these arguments of Whytt are perfectly conclusive. In a similar manner Whytt deals with all the "insensible" tissues of Haller, and is justly led to conclude "If sensibility, then, be a sure mark of the existence of nerves in any part of the body, there is none without them, altho' anatomists will never be able to demonstrate them in every part."[2]

About this time begins a department of our subject which will demand attention in a subsequent chapter, viz.: the rate of the nerve impulse. Shortly before the time of which we are speaking, in 1676, Roemer calculated for the first time the velocity of light. About this time, too, Newton, Hooke and Huygens, between them had developed the idea of the hypothetical ether, which was either projected, or transmitted waves of vibration with the velocity of light. Newton himself was among the first to carry this conception over into the theories of nerve action. In the *Principia*, he advances the opinion that all sensations and movements are excited by the vibrations of a " very subtle spirit" propagated through the solid "capillamenta" of the nerves from the organs of sense to the brain and from the brain to the muscles.[3] In 1649, David Hartley developed this opinion of Newton's into the celebrated vibration theory, calling into action the ether as the subtle fluid of the nerves. This theory suggested a rate of nerve impulse equaling the velocity of light. Another writer of the time calculated the rate of a nerve impulse from the velocity of the blood in the aorta, basing his computation on the theory that the nerve fluid traveled as many times faster than the blood, as the smallest nerve fibril he could find was smaller than the aorta. This gave the

[1] Whytt, op. cit. p. 262.
[2] Whytt, op. cit. p. 268.
[3] McKenderick. A Lecture on Physiological Discovery, Brit. Med. Jour., 1883, p. 995.

unthinkable velocity of over ten million miles per second.[1]
By a simple and suggestive experiment, Haller checked the
tendency toward such fantastic ideas and instilled into the
subject a spirit of moderation, which may very possibly have
hinted to Helmholz his method of actually measuring the rate
of a nerve impulse. Haller's method was, briefly, to read a
number of lines from the Æneid, take the time, count the
letters read, and measure the length of nerve traversed by
the impulse in speaking.   The notions of centrifugal and cen-
tripetal were not so clearly defined then as now, and Haller
made his computation on the assumption that the nerve cur-
rent passed to and from the brain at each effort. But the
rate which he obtained, although accidental, was not far from
correct, viz.: 150 feet per second as compared with 90 feet,
the result of Helmholz' measurement on the nerves of the
frog.

But Haller missed the exact point, the unconscious element
of reflex action; for he maintained that the processes in the
movements of an animal with and without brain were in
essentials the same ; whereas herein lies the chief distinction.

Closely following Whytt began the writings of Johann Au-
gust Unzer, (1727–1799), his "Grundriss," appearing in 1768,
and "Physiologie" in 1771. By calling attention to the fact that
artificial stimulation, whenever applied to a nerve trunk, pro-
duces the same effect as normal irritation, he could point out
more clearly than had been done, the path of a sensory impulse
from the periphery to the brain.   Here, according to Unzer,
it is transformed into a " material idea," which gives rise to
an image in the soul; and from the brain it may pass as a
motor impulse to the appropriate nerves and thence to the
muscles to give rise to what Unzer calls "*motion with con-
sciousness.*"   From this, he distinguishes *unconscious* move-
ments in which the sensory stimulus is, "bent back," "turned
about," reflected" to the proper motor nerve without going
up to the brain.[2] Unzer failed to appreciate the significance
of Whytt's crucial experiment and taught that the reflection

[1] Hermann's Handbuch d. Physiol., Vol. II, p. 14.
[2] Arnold, Johann Wm. op. cit., p. 29 ff.

took place in the ganglia where the spinal roots diverge to enter the cord.

With Unzer came not so much anything new as a general clearing up of the subject preparatory to modern views of the relation between the mind and nervous system. The one to work more especially in the field of reflex action at this time was a contemporary and follower of Unzer, George Prochaska (1749—1820).

Writers, fifty years ago, could not say enough in praise of Prochaska's work. Longet ascribes to him the merit of making reflexes a distinct class of movements.

Prochaska's first important work was published in 1784, and a few words from this will best serve to indicate his earlier views of nervous action.

"At length," he says, "we abandon the Cartesian method of philosophizing in this part of animal physics, and embrace the Newtonian, being persuaded that the slow, nay, the most uncertain road to truth is that by hypothesis and conjecture, but by far the more certain, more excellent, and the shorter way is that, *quæ a posteriori ad causam ducit.* Newton distinguished the inscrutable cause of the physical attractions by the name 'force of attraction;' he observed its effects, arranged them, and detected the laws of motion, and thus established a useful doctrine, honorable to human genius. In this way we ought to proceed in the study of the nervous system ; the cause latent in the nervous pulp, which produces certain effects, and which hitherto has not been determined, we shall call *vis nervosa;* its observed effects, which are the functions of the nervous system, we shall arrange, and expose their laws."[1] Prochaska would use this term in a broader sense than Haller, who confined it to the power with which a nerve caused a muscle to contract. His first law is that the "vis nervosa requires for its action a stimulus, as a blow is necessary to elicit sparks from flint." His other laws do not particularly concern us. For example, stimuli which call the vis nervosa into activity may be material or mental. The vis nervosa may be more active *(mobilior)*, or more

[1] Geo. Prochaska. De functionibus systematis nervosi. Fasic. tertius Annotat. Academ. Prag., 1784. (Todd.)

sluggish, requiring stronger stimulus to produce the same effects. It is augmented or diminished by influences which tend to elevate or depress the powers of life. Prochaska's leaning toward an electrical explanation of nervous phenomena appears early in his career, before the discoveries of Galvani were made known. For example, he recognizes the influence of nerves upon the blood supply to a region, as in the case of erectile tissue, the reddening of the skin upon irritation, or blushing under emotion, and to account for these facts he advances the notion that augmentation of vis nervosa in any part attracts the fluids of the body thither as "sealing wax when rubbed with cloth becomes electrical and attracts small particles to itself."

One of the most important contributions of Prochaska is the definition of the term "*sensorium commune*," an expression used since Descartes with little significance. It is in connection with this that Prochaska elaborates his ideas of the nature of reflex action. "External impressions," he says, "made on sensitive nerves are propagated with great velocity throughout their entire length to their origin, where, when they have arrived, they are reflected according to a certain law, and pass into certain and corresponding motor nerves, by which again being very quickly propagated to muscles they excite certain and determinate movements. This place, in which, as in a center, nerves of sense and motion meet and communicate, and in which, the impressions of sensitive nerves are reflected into motor nerves is called by a term already received by most physiologists the *sensorium commune*." The law according to which the *sensorium commune* reflects sensory into motor impressions is the preservation of the individual.

To prove that reflex actions may be performed unconsciously, Prochaska instances certain movements of apoplectic patients, the convulsions of epilepsy and movements during profound sleep.

In 1786 came Galvani's brilliant discoveries in electricity and Prochaska, as might be expected, was first to work the new doctrine into an explanation of reflex action. He maintains that any irritating body brought into contact with a

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living organism forms a new link in the Galvanic circuit of solid and fluid parts, which constitutes the organism. This causes a quantitative and qualitative change in electric tension which is conducted by the nerves to the brain where it produces sensation. The "changed tension of the brain acts as a reflex of the irritation upon other organs and excites them to peculiar activities adapted to remove the unpleasant irritation and to retain those which are pleasant."[1] Thus reflexes have for their general law the preservation of the organism as before, and are "founded on electrical attraction and repulsion of advantageous or injurious irritations according as the polarities of the organ and the irritation are identical or opposite." So Prochaska went to seed in the idea that " physically considered, vis nervosa is pre-eminently a principle of life which reveals itself to us in electricity.[2] As Eckhard remarks in effect, neither Unzer nor Prochaska had unequivocal experimental grounds of their own, as Whytt had, for believing that reflexes could not take place in peripheral anastomoses.[3]

But the century did not close without witnessing the beginnings of some good experimental work in reflex action. Sir Gilbert Blane (1747—1834), on young kittens, and Legallois (1770—1814) chiefly on rabbits, redemonstrated the experiments of Whytt made on the frog, proving that portions of the cord in these animals, as well, could function as reflex centers for the corresponding parts of the body. But the work of these men marks rather a renewal of interest in this sort of investigation than the contribution of anything really new.

For Legallois, animals are constructed to move and to feel. We might, he says, suppose that the power to do this resides in all parts of the body equally, were it not for the fact that the instant a nerve is cut, all sensation and motion vanishes from the parts below the section. Hence the source of power must be sought in the source of the nerves, i. e., in the brain and spinal cord. Destroy these, and all power of motion or

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[1] Prochaska. Physiologie. Vienna, 1820, p. 85. seq.
[2] Prochaska. Vorrede, pp. 9 and 10.
[3] Eckhard, op. cit. p. 50.

sensation is irrevocably lost. But, "if instead of destroying the cord, transverse sections are made, each part of the body corresponding to each section retains its own sensation and voluntary motion; but the sections act without harmony and as though independent of each other, as if, in fact, the sections had been carried through the entire body of the animal. In a word there are as many distinct sensory centers as there are segments of the cord."[1]

The committee appointed to report on Legallois' memoir explained that he believed that the cord acted not merely as a medium of communication between different parts of the body, but that the principle of life and the power which animates the whole body proceeded from it.[2] To prove this, it was admitted, Legallois brought forward abundant and conclusive experiments. Another important point brought into prominence by the use of warm blooded animals is the direct and immediate dependence of life in the cord upon the free circulation of blood through it. Thus while Legallois contributed little that is entirely new, he certainly emphasized and enlarged that which is of most value in the work of his predecessors, and gave to investigation of nerve action a new impetus and direction.

The truth itself could hardly have awakened more profound and universal interest than the error of Galvani, already described in the introductory chapter. But with this excitement naturally enough arose a cloud of speculations which again involved the subject of nerve action in lawless confusion. Even Alexander von Humboldt, as late as 1797, was led, in spite of the good experimental evidence of Whytt, into the most laborious attempts to explain sympathy between different nerves by "conduction" and anastomoses, and proximity of origin of nerves, and by the fact that one nerve lies in the "sensible atmosphere" of another.

How this confusion is cleared up by the timely discovery of a law as important to nervous action as that of circulation to the physiology of the blood must be reserved for a subsequent chapter.

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[1] Œuvres de Legallois, Paris, 1830, Vol. I, p. 135-6.
[2] Legallois. op. cit., Vol. I, p. 265.

MINOR CONTRIBUTIONS.

OBSERVATIONS ON COLLEGE SENIORS AND ELECTIVES IN PSYCHOLOGICAL SUBJECTS.

By E. A. KIRKPATRICK, Scholar in Psychology at Clark University.

A few years ago Dr. G. Stanley Hall, then professor of psychology in the Johns Hopkins University, asked eleven professors of philosophical subjects in all the larger eastern and two western colleges or universities, to request their senior students near the close of their last year to answer carefully and in writing the few simple questions below. From these answers about two hundred and twenty were selected for this report. Nearly all received were deliberate and serious and not a few were elaborated to considerable length. They do not admit of statistical presentation, but, collated as below (chiefly in the *words of the student, each clause representing a person*), form a composite portrait of the positions held, and the educational value of these studies from the student standpoint, of significance for teachers of these subjects. They have not only educational but anthropological significance, and reflect many sides and phases of mental evolution or psychogenesis which an ordinary examination paper does not touch.

I. The first question was *why these studies were chosen*. Here only answers where these studies are elective or optional are considered (178). Excluding nearly a score of cases where the determining factor was the advice of parents, a friend, or personal liking for the professor, or respect for his reputation, or a choice between two or more evils to avoid a still more hated study, the motives fall readily into the two classes of utilitarian and more purely educational. Five chose psychology as a study useful for medicine, three chose philosophical subjects as helpful for law, twenty as a preparation for theological study, four each for history and literature, others as a help to know character, to know motives and how to deal with men, to know self and others. The less practical objects sought by thirty-nine were mental discipline or culture; thirty-six sought further light in problems in the field of natural history including evolution, seven sought a better grasp of problems in physical sciences, about three-score sought light on religious and ethical questions, or it was a chance discussion of free will that had turned the scale.

Some wanted help to judge of doubtful acts, many had theological doubts they hoped to have cleared up, or wanted to find a few certain beliefs, or to obviate trouble that had arisen about materialism, agnosticism, evolution, or necessity and freedom, in this order of frequency. Other reasons were specified as follows: to avoid the fatal narrowness of the specialist, to learn to detect and avoid fallacies, to get insight into mind, and rational processes and laws as a necessary part of a liberal education, because it was as broadening as classics, to learn of the great teachers of the world, from interest in phrenology, had heard of Berkeley and idealism and would know what it was all about, from interest awakened by a phrenological examination, to counteract the effects of Kant, as an harmless and elevating amusement, to increase general intelligence and to know that Kant did not serve under Cæsar and that Plato was not a Dutchman, to get poise between the extremes of empiricism and rationalism. Several hoped to gain a birds-eye view of the whole field of knowledge, or to see the background of the sciences, to be able to understand and talk intelligently upon the important questions of the day, to see how philosophy dealt with the questions of science, to learn what the great minds of the world had thought upon its greatest questions, or to find the last and best words of the greatest thinkers of every age upon subjects of greatest interest to man in his highest capacity. One could not tell why it was chosen, but took to it as a duck to water, one believed himself best fitted for and most likely to excel in it. One had before found it a part of his life. One expected to find it the basis of all other studies and had heard of it as the science of sciences. Another thought it the résumé of all other studies. Another reasoned, that as science dealt with matter, and philosophy with mind, it would teach him how to deal with men. One thought that as it was abstract it would require and develop more keenness of insight and power of application. One had wondered what thought was, anyway, and how great minds worked. One would learn to direct his life by it, to influence others more, it would help and insure progress, or to get settled in belief, strengthen conviction, to learn to tell false from true, to get a foundation, to clear up the question of immortality, to settle the question of inspiration of the Bible and miracles, to know God and duty, to understand the relations of mind and matter, to know the great problems of the world and of individual thinkers, to get rid of dogmatism, to gain independence of thought, power of generalization, ability to make comprehensive judgments, to arrange very unassimilated facts, to concentrate and direct my efforts, to know general principles, to get the

habit of accurate thinking, to develop my mental powers as far as possible.

Among the more elaborated and detailed answers to the first question are two which give great prominence to a love of discussion and debate, and the strange magical attraction of all questions which had two even sides or even those in their nature insoluble; several whose philosophical interest began at some particular moment, perhaps in early boyhood, when the question occurred suddenly, perhaps before a mirror, "Who or what am I, what is I, or how did I come to be I and not some one else in part or in whole?" and speaking one's own name or gazing at it written, as in a spell, increased the self-estrangement and wonder. Several describe a great growing sense of the strangeness and unreality of all things, and even persons about them. What are things; are they real; what do I and they mean? One was possessed for years with the haunting suspicion that probably only things at the moment attended to were really real, and all others, perhaps, passed out of existence. Several had spun crude theories of their own they wished to test. Two describe an attack of theological skepticism with detail, which, especially in one case, is pathetic and almost magnificent; and one had had a prolonged and hardly less serious experience with the problem of free will, which these studies were to clear up.

II. The second question was, "*what have you already gained of value from these studies?*" Only six profess to have gained nothing. Of these, one hated it, another had forever lost his peace of mind and wished he had never heard of philosophy, two had had their curiosity deepened (one would study it forty years like Kant before he could answer this question), two still had little, but expected much. Another small group of students had been made more discriminative but less confident, if anything, or had concluded that commonsense, or in one case, unreflecting conscience was not a safe guide, one that all off-hand judgments were worthless, one that to actually prove anything was impossible, one that the contradictions of experience could not be reconciled, one that things were not as they seemed, or not so real after all. One had come to so hate introspection and analogies that he would escape their paralyzing effects by becoming as much of an animal as possible. One had gained so many more doubts than he ever heard of before that he was miserable and had even meditated suicide at two different times. Two had learned that their mission was to combat or expose agnosticism, skepticism, materialism or determinism.

The chief advantage gained and most often specified was

religious. The most common or typical phrases are as follows :—Clearer apprehension of God and duty ; satisfied all my formerly grave intellectual difficulties about religion ; shown me the ground for my religious belief ; made me able to comprehend the divine government; removed the sense of conflict between science and theism ; shown me the authority of the bible, God, immortality ; convinced me of free will; revealed the truths at the basis of religion ; has brought me by considering non-christian truths to understand and see the superiority of christianity ; my ideas of God and nature are changed, enlarged, established ; has revealed solid foundations by clearing away much rubbish in religion ; has taught me to respect sincere doubts and to relieve them ; has given me a few positive convictions to live and work by ; has settled the mind and given faith better foundations.

Nearly all specified one or more of the following motives or notes :— *Growth*, e. g., gained mental development ; made a man of the boy ; matured me more than any other study ; more than all the previous three years ; the evolution of the highest truths from many systems has aroused me, compelled reflection, generated in me a new life, etc. *Discipline :*—e. g., increased my power of application ; quickened perception and apprehension ; made me able to deal with abstract ideas and questions ; to choose premises and reason logically ; to analyze all things and see the relations between parts and the whole ; to see fallacies and direct the parts in a discussion ; to concentrate and direct all my efforts ; given the habit of accurate thinking; to exercise the mind rather than cram it with facts, etc. *Unity and relation :*—e. g., it has given unity to my mind and to all my life ; shown me my relations to others and to universal truths ; has shown me one basis for all future study ; that the relation of things is the form of reason ; that all knowing is relating ; taught the organic unity of the world. *Breadth and depth :*— It goes to the bottom and gets absolute proof of things ; gives the habit of looking at the nature of things and shows reasons and causes, principles vs. facts, meat vs. shell, makes candid and fair-minded ; shows subjects in all their bearings ; goes to the heart of things and teaches the folly of superficiality; have been greatly broadened and deepened, etc. *Miscellaneous matters cleared up :*—Evolution, relation of mind and matter, and of brain and thought; has shown the great problems of the world one by one ; gives insight into the turning points of great questions ; the keys to the treasure house of knowledge ; kills all prejudices against men and views ; shows me my mistakes in thought and action; makes me tolerant of even unpopular things, and to make allowance for even

children and the ignorant; feel the necessity of testing all
theories ; gives an idea of human progress and the unity of
history; turns the mind in on itself; gives new and stronger
interest in all other branches of knowledge; freedom from
conventionalism and dogmatism.

To illustrate the form of these very interesting returns I
quote from a few.

1. I have at last won a few convictions I can live by and
preach. They have brought me much peace. I have been at
sea a long time ; I have now landed and got a little patch of
ground to cultivate ; I begin to feel the blessedness of a
purely individualistic mental attitude, and this is the label of
my creed.

2. I have been deeply interested in philosophy and philos-
ophers, but have adopted no particular opinion and cast no
anchor. I have been working by myself on criteria of truth
and grounds of belief. I feel and believe we know some
absolute truth, but I am at a loss to know from either books,
professors, or my own thinking, how I shall be certain as to
what is absolute truth. I expect to outgrow this state and so
keep right on studying. I am looking for a modest postulate
to start with. Reaction from Prof.————'s dogmatic the-
ology first caused me to study philosophy.

3. The desire for a unitary and harmonious mental uni-
verse has been the most conscious if not deepest motive in
all my philosophical study and reading. My second great
interest is in history as a development of thought. The results
of philosophic study for me have been largely negative,— an
emancipation of the mind. I am less imposed on by theories
and terms. Even ideas like substance, cause, necessity, render
up their absoluteness. As a cathartic for purifying and
purging the mind nothing equals philosophy. I have gained
also a few fixed points or fundamental ways of looking at
things, e. g., the absolute oneness of the universe and the
general truth of idealism, the laws of intelligence or insight
into the structure of the universe.

4. I have determined to devote myself to philosophy from
love of unravelling, tucking in ragged edges, and generally
transposing my ideas from a more chaotic to a more syste-
matic and concentrated shape,— a formal interest therefore.
At the outset, the *material* mystery of what the nature of the
world is, whether rational or otherwise, goaded me a good
deal and I hoped for a solution. At present, I do not hope
for it in the way I did then, as a decision *positive*. I believe
philosophy shows us that we are entitled to make practical
assumptions in the matter, skepticism itself being the assump-
tion of a definite practical attitude. This *permission* on the
part of philosophy I reckon a great material gain.

III. *Whose writings in these fields have impressed you most?* The answers are in order of frequency beginning with the authors most numerously preferred :— Herbert Spencer, Kant, Emerson, George Eliot, Plato, Carlyle, Hume, Hegel, Descartes, Darwin, Huxley, Kingsley, Cicero, Wordsworth, Keats, J. S. Mill, Locke, Pope, Jevons, Schwegler, Coleridge, Paley, Max Müller, Joseph Cook, Flint, G. H. Lewes, Hawthorne, Browning, John Fiske, Hickok, Bushnel, Edwards. Many others received individual mention.

IV. *What subjects covered by the courses in this department have interested you most?* The answers, again in order of frequency, were as follows :— Evolution, deity, theological questions, free will, psychological marvels, idealism, agnosticism, animal intelligence, origin and validity of knowledge, heredity, pessimism, pantheism, immortality, brain-centres, hypnotism, education, space and time, progressive orthodoxy, transcendentalism, nebular hypothesis.

Material so diversified can be presented statistically only with some arbitrariness, but if it is hard to count, it is still harder to weigh. It is surprising that the respects in which the standpoint, opinion or method of the different professors, institutions or even the different philosophical disciplines differ are almost never apparent in these returns. On the other hand the most diverse degrees of both maturity and proficiency are strikingly manifest. Most became deeply interested and thought they found great good and enlargement which was very rarely measured by utilitarian ends. There is also a genuineness, sincerity and great earnestness about these unformed first boy-manish impressions of the great problems of the world and man, and hardly a trace of affectation. These matters are real, the interests are living, and a few papers could be selected as constituting an ideal examination far deeper than any professor's questions go. If all instructors would habitually append question II to every examination paper they would, we think, learn very much of value to them as teachers concerning the forms of youthful interest that are strongest, and the bottom quintessential wisdom that abides, and would thus be able to greatly, if slowly, increase their pedagogic powers of adaptation. If this kind of investigation were followed out in more detail much further light would be shed, we are convinced, upon the practical question of electives, and upon the psychological anthropology of the later stages of adolescent maturity.

A more comprehensive collection and a more detailed study of such returns in the light of this general and preliminary survey would, without a doubt, yield results of great scientific and practical value.

A SIMPLE AND INEXPENSIVE CHRONOSCOPE.

E. C. SANFORD, PH. D.

The application of the principle of the vernier to the exact measurement of time was suggested forty years ago by Kaiser, the veteran astronomer of Leyden.[1] From an abstract of one of his papers in an early volume of Carl's *Repertorium für physikalische Technik*, the suggestion here to be developed was received.

In principle, the instrument is as simple as possible— nothing more than two pendulums, one swinging across its arc in a second, the other in a little less or a little more than a second; for example, in ninety-nine hundredths. The more rapid one will then gain on the slower one a hundredth of a second in each swing of the latter, and when they start together will exactly coincide with it at the one-hundredth swing, the two-hundredth swing, and so on. The application of the instrument is equally simple. Required the time that elapses between the beginning and end of some phenomenon —say, the fall of a ball. When the ball starts, the full second pendulum is started; when the ball stops, the more rapid pendulum is started. The latter gains one one-hundredth of a second during each swing of the former, and finally overtakes it. It is, therefore, only necessary to know the number of swings made by the slower pendulum before this happens, to know the number of hundredths of a second intervening between the starting of the two pendulums, or between the beginning and end of the fall of the ball. More explicit examples will be given below.

In the actual construction of such an instrument two points need care; namely, the starting of the pendulums, and the recognition of the swing in which they exactly coincide. The first is rather easily managed, by having the pendulums held at one end of their arc by electromagnets and releasing them by breaking the electric circuit. The other also may be

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[1] "On a new application of the principle of the nonius to the exact observation of sudden phenomena." *Tijdschrift voor de Wis- en Natuurkundige Wetenschappen.* Vol. v, 1851. Also applied by him to the measurement of astronomical personal equation: De volledige bepaling van persoonlijke fouten bij sterrekundige waarnemingen. *Verslagen en mededeelingen der akademie der wetenschappen, Amsterdam, Afdeeling natuurkunde,* xv, 1863, 173; also in abstract in the *Archives néerlandaises des Sciences,* Harlem, I, 1866, 193.

accomplished by making the two pendulums, when they coincide, complete an electric circuit themselves, in which is placed a telegraph sounder.   In the cut below, Fig. I represents the pendulums as seen from in front, pendulum B held by its electromagnet, pendulum A at rest in its middle position.   T is a little trough of mercury into which platinum wires s s, at the lower end of the two pendulums, dip when the pendulums are in their middle position.   From these platinum points wires (not represented in the figure) run up the pendulums to the knife-edges (Fig. I, k, Fig. II, k and k') on which the pendulums rest.   In Fig. II is represented the shelf by which the pendulums are supported.   The knife-edges rest upon metal
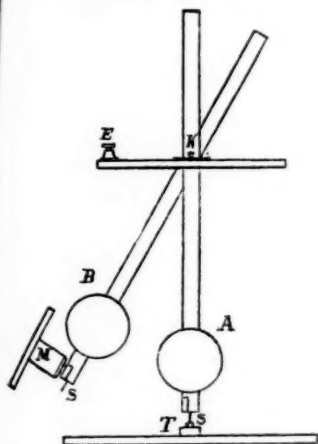

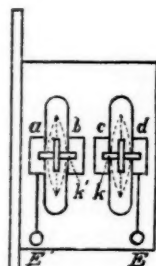Fig. I.

Fig. II.
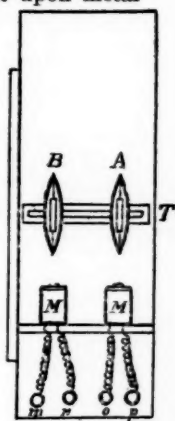
Fig. III.

plates, a b c d, fastened to the shelf ; and from two of these, a and d, wires are lead to the binding posts, E E'.   Now, when the wires of an electric circuit are fastened into these binding posts, the circuit will be complete when the platinum points of both pendulums are in the mercury of the trough, and at all other times will remain broken.   When the pendulums are at rest the circuit will be continuously closed.   When they are swinging it will be closed (and the sounder will click), as often as both cross the mercury at the same time, either going in the same or in opposite directions ; that is, when they coincide or are just halfway between coincidences.   Fig. III is a plan of the instrument at a level just above the pendulum bobs (A and B), showing the electromagnets, M and M, and the mercury trough, T.

The ease with which a tolerably accurate instrument of this kind can be made, and its very small expense, will appear if I describe more fully one recently made here in the carpenter's shop of the physiological department. The framework of the instrument is a pine board a foot wide and about two feet long, kept upright by horizontal pieces nailed to its sides at the bottom. About halfway up, on the face of this board, is fastened a shelf three and a half inches wide, through longitudinal slots in which the pendulums hang. The pendulums, which in this case swing across their arc in approximate half-seconds, instead of whole seconds as in the example above, are about 20 inches long. Their rods are pine slats about seven eighths of an inch wide and three sixteenths of an inch thick. The knife-edges, which are put through the slats a little above their middle, were made by filing bits of eighth of an inch iron wire into triangular shape; and to hold them in place, they are soldered to little bands of tin that encircle the pendulum rods just above them. The plates on which the knife-edges rest are small pieces of sheet brass screwed to the wooden shelf, and have shallow notches filed in them to keep the knife-edges from getting out of place in the ordinary handling of the pendulums. The pendulum bobs are made of sheet lead, several thicknesses being cut in oval form and bent around the rods and their edges caught together with solder. They weigh not far from three quarters of a pound apiece. They were made so as to slip tightly upon the rods till a coarse adjustment could be made, and then were fixed in place by driving a headless pin through each. The electromagnets, the two bobbins of such a magnet as is used in ordinary telegraph sounders, were screwed to a bit of wood and fastened at the proper angle to the back piece of the instrument and to one of the side pieces that keep the latter erect. The mercury trough was made by filing a groove about an eighth of an inch wide and an eighth of an inch deep in a small piece of hard rubber, and damming up the ends with sealing wax. This trough was further fixed with sealing wax in a shallow china dish to catch any mercury that might be spilled, and the whole was adjusted by hand, so that the platinum points rested in the middle of the mercury when the pendulums were at rest. The electromagnets and six binding posts can be bought ready-made for one dollar and sixty cents respectively; a quarter's worth of sheet lead is ample; the bits of brass, the hard rubber for the mercury trough, the platinum wires, the boards for the frame, etc., etc., together should not cost more than a dollar—a total of two dollars and eighty-five cents. While this instrument was not carelessly made, it lacks, as appears from the above description, the fine adjustments

and many of the conveniences that could readily be supplied by an experienced mechanic, and, in especial, it lacks the permanency of adjustment that an instrument so made would certainly possess.

The regulation of the instrument is an important and somewhat tedious matter, but not a difficult one. In our instrument the pendulums will continue to swing long enough to be counted for several minutes. If one is at rest with its point in the mercury, the other will make and break circuit at every swing, that is every half-second, and its vibrations may be counted from the clicks of the sounder, a process which practice considerably facilitates. If the observer follows the pendulum with his eye he finds the task a little easier—at least it seems so to the writer—and he has the further advantage of a constant check on his counting in the fact that the pendulum moves one way for all odd numbers and the other way for all even numbers. To find the rate of the pendulum, the observer listens to the clicks of the sounder, following at the same time the second hand of his watch till it marks a division simultaneously with a click, counts that naught, the next click one, and so on for five minutes or more as he desires, and thus discovers how nearly his pendulum makes the required number of swings. In this way it is not difficult to get the number to a single vibration. The following are the results of several such counts, on the slower pendulum of our instrument, made at one sitting.[1]

Count by	half-seconds for	9	minutes :	1082	against	1080	required.
"	whole seconds "	10	"	602	"	600	"
"	half-seconds "	9	"	1082	"	1080	"
"	whole seconds "	10	"	601½	"	600	"
"	half-seconds "	10	"	1203	"	1200	"
"	whole seconds "	9½	"	572	"	570	"

It will probably be found convenient to leave the pendulum with a small error, and make a numerical correction, if necessary, in the final results.

Having fixed the rate of the full time pendulum, a more rapid way is open for the setting of the other. After a coarse adjustment by counting, the two magnets may be brought

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[1] The pendulum completes a vibration in a slightly shorter period as its arc grows smaller; measurements made on the slower pendulum with the tuning-fork (though on another occasion, when a single count showed the rate of the pendulum itself a trifle slower) gave the following values in thousandths of a second as the time of a double vibration; At the start, 1000.9; after five minutes, 998.4; after nine minutes, 996.5 If we assume that this increasing loss is equivalent to a shortening of each of the six hundred double vibrations by an amount equal to the loss shown after five minutes, we get something over one and a half as the number of vibrations gained by the pendulum upon itself in ten minutes.

into one electric circuit, and the two pendulums released at the same instant by the breaking of that circuit. The swings of the slower pendulum may now be counted till the two are exactly in opposition (halfway to a coincidence), which should occur, if the rapid pendulum is nearly right, after about one hundred half-seconds; or, if one prefers, the count may be carried on to a coincidence which should occur after about 200 half-seconds. The error is thus found by counting one or two hundred instead of five hundred or a thousand. A very little change in the pendulums shows itself at once in the number upon which the opposition or coincidence occurs; a difference of one ten-thousandth of a second in each vibration, amounting to one one-hundredth of a second in one hundred vibrations, will make a difference of one in the number of the vibration in which the opposition or coincidence occurs. Indeed, the required change of adjustment is often so minute that it is convenient, as before, to leave a small error for numerical correction. The difference between tables *A* and *B*, below, are probably due to small accidental disturbances of adjustment or to spontaneous changes in the materials of the instrument; and even larger differences have sometimes been found, but so long as the rate remains constant during a series of experiments, accurate results can be obtained by correction, even from such a machine as the one above described.[1]

A.—Table showing numbers (half-seconds) on which occurred the clicks marking opposition and coincidence.

April 8.	Opposition.				Coincidence.			
	100	101			200	201		
99	100	101		199	200.	201		
	100	101			200	201		
	100	101						
	100	101			200	201	202	
99	100	101			200(?)	201	202	
	100	101				201	202	203
	100	101				201	202	
	100	101	102(?)		200	201	202	
	100	101				201	202	

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[1] As these tables show, the clicks do not indicate a single swing of the pendulum, as that to which the opposition or coincidence belongs, but two at least, and sometimes three. This, however, is not a serious disadvantage; for if three are indicated, the opposition or coincidence falls most nearly on the middle one of the three, or if two, between them. Indeed, it is sometimes possible to tell from the different intensity of the two clicks, which stands nearest to the exact opposition or coincidence.

B.—Table showing numbers (half-seconds) on which occurred the clicks marking opposition.

April 12.

First Series: Opposition.				Second Series: Opposition.		
	101	102	103	100	101	102
	101	102	103(?)		101	102
	101	102			101	102
	101	102			101	102
100	101	102			101	102
	101	102				
100	101	102				
100	101	102				
100	101	102				
100(?)	101	102	103(?)			

Another possible error, and one of a most serious kind, is introduced if one of the magnets holds its pendulum longer than the other after the breaking of the circuit, which is especially likely to happen if the cores of the magnets are allowed to become permanently magnetic. To prevent this, in using our instrument, a commutator has been put into both circuits, and the direction of the current changed at each test[1]. Fortunately, the instrument itself affords a means of detecting this error, if it amounts to more than four or five thousandths of a second. Assuming that the speed of the pendulums at the start is such that the breadth of the trough of mercury is represented by .007 sec., there will be a click from the sounder every time that one pendulum is within .007 sec. of the other, as the two cross their middle position[2] Under these circumstances, three things may happen when the pendulums start at or near the same instant. (*a*) If the rapid pendulum starts more than .0045 sec. ahead of the slow one, and gains on the slow one (as it does), one quarter of a hundredth of a second in the quarter second before it reaches the mercury, it will be clear of the mercury before the slow pendulum enters it, and there will be no click of the sounder. (*b*) If the slow pendulum starts even as little as .0005 sec. ahead of the rapid one, the latter will only be .002 sec. ahead when both cross the mercury, and there will be a click of the sounder, and again when the pendulums come to the mercury on the return swing, the more rapid one having gained half of a hundredth of a second more, it will

[1] If such an error were present, it might be balanced in the result by interchanging the pendulums, so that the error should affect one for the first half of the series of measurements, and the other for the second half.

[2] This seems a fair assumption, for if the pendulums cause a click when separated by .007 sec., a coincidence would always be marked by two clicks and might be marked by three, a condition of things which the tables already given show to happen after the pendulums have already swung fifty or one hundred seconds.

be but .007 sec. ahead, and will cause a second click. (c)
When the rapid pendulum has less of a start than .0045 sec.,
or the slow one less of a start than .0005 sec., there will be a
single click as they cross the mercury, and no second click
till they reach opposition.

To test the accuracy of the instrument in actual measure-
ments, it was used to measure the time of the falling of the
ball in the apparatus ordinarily used for regulating the Hipp
chronoscope, the apparatus having been fixed to break a second
circuit instead of closing the first, as in the common arrange-
ment.　The calculated time for the fall of the ball *in vacuo*
was 319.28 thousandths of a second.　The average of fourteen
measurements taken with a vibrator making sixty vibrations
a second, gave the actual time as 331.2 thousandths of a
second.　Ten measurements with the pendulums (counting
half-seconds) gave the following as the numbers of the swings
upon which the clicks of the sounder indicating a coincidence
occurred :—

April 12.	67(?)	68	69		67	68	69	
	67(?)	68	69		67	68	69	
	67	68	69		67	68	69	70(??)
	67	68	69		67	68	69	
		68	69		67	68	69	

Neglecting the doubtful numbers (for which the click was
very faint, if there was any at all), the average number for
the coincidence is 68.15　These, however, are half-seconds;
the number of seconds (and the corresponding number of
hundredths of a second) is 34.075, or, in thousandths of a
second, 340.75.　This first result is, however, subject to cor-
rection.　In the first place, each swing is counted when the
pendulum is in the middle position, while the start is made
from an extremity of the arc; a quarter of the gain of a double
swing, *i. e.*, .0025, is therefore to be added to the above result,
making 343.25.　In the next place, the rapid pendulum did
not at this adjustment of the instrument reach an opposition
at 100 half-seconds, but on the average at 101.3 (see table B
above).　Each one of the 68.15 half-second swings enumerated,
therefore, represents, not $\frac{1}{100}$, but $\frac{1}{101.3}$ of a swing of the slow
pendulum.　Reducing, accordingly, to an exact adjustment
gives 67.28 half-seconds and 33.64 hundredths of a second, to
which, when .0025 is added, as before, a final result is
reached of 338.9 thousandths of a second—7.7 thousandths
of a second in excess of the result obtained with the vibrator.
No correction is here applied for error of the slower pendulum,
which on this occasion is believed to have been insignificant.
In two other series of measurements made at another time,
one of 10 and the other of 25 trials, the coincidence fell
between 67 and 68 seven times, on 68 once, between 68 and

69 twenty-four times, between 70 and 71 twice, and between 72 and 73 once, the amount of the last three being not impossibly connected with irregularities in the fall apparatus itself.

A better made instrument might give better results, but the accuracy attainable with this is sufficient for the demonstration of nearly all the more important facts of simple reaction-times, and abundantly so for the longer and more complicated reactions with discrimination and choice and for association-times, where the average variation of the single tests in a series may itself amount to a tenth of a second or more. For many of these purposes, a pair of pendulums adjusted to measure twenty-fifths of a second would answer well enough, and the regulating of them and the counting at each observation would take but one fourth the time. The instrument has two advantages aside from its simplicity and cheapness. It is silent in its operation, and so may be used in taking reaction-times in the immediate presence of the subject. And it is well suited to lecture demonstrations, for a whole roomful can easily see that one pendulum starts before the other, and can count the swings to a coincidence, to all intents taking part in the observation themselves. The instrument (in the absence of any other name, why not call it a *time-vernier?*) would be greatly improved by adding a dial and second hand, so as to make the counting automatic, and probably also by swinging the pendulums between points instead of on knife-edges. Care in keeping the mercury clean and the contact good at the knife-edges is, of course, essential to a satisfactory functioning of the instrument.

3

PSYCHOLOGICAL LITERATURE.

1.—NERVOUS SYSTEM.

Untersuchungen über die Physiologie der Froschhirns. DR. J. STEINER. Braunschweig, 1885.

Ueber das Centralnervensystem der grünen Eidechse nebst weiteren Untersuchungen über das des Haifisches. Prof. J. STEINER. Sitzungsberichte d. Königl. preusischen Academie d. Wissenschaften zu Berlin. XXXII. 1886.

Die Functionen des Centralnervensystems und ihre Phylogenese. Zweite Abtheilung; Die Fische. Prof. J. STEINER. Braunschweig, 1888.

The work of this author on the physiology of the central nervous systems of the fish, amphibia and reptiles, has already continued for nearly ten years. Since the first paper on the physiology of the frog's brain, his general plan has widened, so that in his last publication he states his problem as the study of the development of function in the brain and cord of the lower vertebrates. In this study he is guided by the same general rules that control morphologists in tracing the phylogeny of structure. This might be called a chapter in comparative physiology, but in that case it is only fair to add that it is undertaken from the standpoint of the doctrine of evolution, which certainly adds a fresh interest to the results. This is perhaps not quite so novel as Steiner feels it to be, but that is a small matter in comparison with his observations. The technique used was excellent, and all precaution was taken to escape confusing and doubtful results which should depend on careless operations. The most suitable places for work were chosen, and to that end the principal study of fishes was made at the Naples station, where the facilities were best. The results are stated for each group of experiments, and then in a separate section the theoretical considerations are dealt with alone. This theoretical portion is certainly of interest, but when, for instance, it takes the author into speculations on the origin of the forebrain of the vertebrates, he is perhaps carried too far. Taking the papers in chronological order, the physiology of the frog's brain comes first, and this order is the best to follow, as the physiology of the central nervous system in the frog is better known than that of the other animals employed.

Rana esculenta was used, and the cerebral hemispheres were first removed. Such a specimen remains quiet, as a rule, when not in the water. If excited by mechanical stimulation, makes one or more jumps, and then comes to rest. When jumping it can see, and so avoid objects in its path. When the path is free, locomotion is in a straight line, but if there is an obstacle in the way, it, under certain conditions, either jumps over or around it. Although, when quiet, threatening motions of the hand are disregarded, yet the same specimen, once started in a series of jumps, avoids capture, often with unexpected success. The conditions that determine whether the frog shall jump over an obstacle to be avoided, are that the obstacle be not too high, for if too high the frog will not even make the attempt; and that it shall cast a dark shadow in the path, for if a plate of clear glass be put in the way, the frog jumps *against* it. Where the object is too high, the frog avoids it by jumping to one side. Something of the direction of leap

in reference to an obstacle can be predicted from the motions of the frog's eyes. This same specimen balances well on a board, the plane of which is varied in the usual way. In many cases the frog slips when being thus tested, and to prevent injury the observations were made over water. When put in the water the frog swims to the edge of the aquarium, then stops swimming, and some specimens seek to get out of the water before they come completely to rest. This performance varies with different individuals, and with the same individuals at different times. It appears that when the air is warm, and the light bright, they are most likely to execute this final act. When put on its back, such a frog at once turns over to the normal position. In discussing these observations, Steiner points out that the loss of the hemispheres removes all spontaneity from the specimen. The so-called spontaneous movements on land are probably due to unobserved stimuli. Though nothing could appear more spontaneous than the swimming motions in the water, yet these are almost certainly due to the stimulus of that medium, for when the frog leaves the water the motions cease. Balancing and turning from the back to the normal position, Steiner argues to be dependent on the tension of the muscles connecting the trunk of the body with the head. We shall not enlarge on this point, on which he lays considerable stress, further than to state that he makes out a strong case. One experiment of interest in this connection is, that if the skin be removed from the back of such a frog and then he is laid on his back, he nevertheless turns over, showing that the action is due to something besides skin stimulation. In another connection Steiner brings out the fact that of the cerebral hemispheres it is the basal portion that is most important to the frog, for if the mantels of the hemispheres alone be removed, the specimen appears perfectly normal.

In the next operation the hemispheres plus the interbrain were removed. When this is done with a knife the optic nerves are also severed, and the frog is blind. This frog can jump fairly well, but does not pull himself together at the end of a leap with the same rapidity and sureness as one which has lost his hemispheres alone. He swims normally when put in the water, but does not try to climb to the edge of the tank. When laid on the back he will turn over; but when the experiment of balancing is tried, although the head is moved as the plane of the board is changed, no effort is made to get the body into a balanced position. Such specimens still croak reflexly. The interbrain is further a centre for the chromatophores in the skin. After operation all specimens become dark, and remain so persistently. To meet the objection that the loss of sight was responsible for some of these results, Steiner severed the thalamencephalon without cutting the optic nerves. Though such a frog can see, this advantage did not modify his action in any of the points just mentioned. To explain these results, Steiner assumes that the interbrain is a centre for sensations from the muscles, joints and skin, and that it is the loss of these sensations which causes the additional disturbance.

When the optic lobes, or mid-brain, as Steiner prefers to call them, are removed, a new complication appears. If the removal is not strictly symmetrical, forced movements occur. To this subject Steiner gives much attention, and such movements form an important criterion in his later speculations. In this connection, however, the cases where they do not occur will be specially considered. On mechanical stimulation, the frog without his mid-brain leaps normally. He is blind, and jumps against obstacles. When put in the water he swims, but in an uncoördinated manner. Considering the *lobi optici* as made up of a roof and base, for each lobus has a central cavity, it appears that the roof has no motor function, but is connected with vision alone, whereas the base has

motor functions. After the base is removed, the " croak " reflex cannot be obtained. Besides the loss of the special function of vision located in this region, there is the more general disturbance which might be considered as due to the removal of such central elements as were supposed for the interbrain.

When the cerebellum of the frog is removed, in addition to the parts lying cephalad of it, there is no additional disturbance. When, however, the cerebellum alone is removed, a slight trembling of the limbs, on certain occasions, and a loss of exactness in some of the muscular movements, were the symptoms observed.

Finally, if the most cephalic portion of the medulla oblongata is cut off, a marked change occurs. Though on mechanical stimulation the limbs are moved, there is no locomotion. The frog does not rest in the normal position, but flat on its belly; when placed on the back, it remains there. Put into water, no swimming motions are excited. In considering the remarkable effects which follow this last operation, Steiner reaches the conclusion that this region contains a coördinating centre for all the muscular motions, or a centre for locomotion. This centre is prominently brought out in the study of other forms, and to it therefore Steiner attaches great importance.

In those cases where the brain, including the mid-brain *(lobi optici)*, had been removed, certain irregularities of reaction were observed, which led to a further study of the region. This was made by first removing the cephalic third of the mid-brain. Such a frog was but little different from one which had lost the interbrain alone. He still gave the " reflex croak." When the cephalic two-thirds were cut away, stimulation did not make him creep or jump, but the frog moved backwards. This backward motion was then a function of the caudal third of the mid-brain. By the removal of parts of the brain in an asymmetrical manner, a great variety of forced movements can be produced. A review of these, while of much interest, must be omitted here.

Having thus given in some detail the observations on the frog, those on the other animals may be stated more briefly. When the forebrain of the green lizard *(Lacerta viridis)* is removed, the animal remains motionless as if asleep, from time to time opening its eyes. When irritated it wakes up, so to speak, runs off a short distance, and again relapses into its dormant state. In this case locomotion is normal, but the lizard runs as readily towards the operator as away from him. It has no fear. It can at the same time see, for it avoids obstacles in its path. The lost functions are located, however, in some portion of the hemispheres which is not the mantel, for when that only is removed the creature runs when frightened by a movement towards it, and eats and drinks voluntarily. The removal of the interbrain plus the hemispheres introduces chiefly a change in locomotion, whereby the specimen when excited runs a few steps and then gives a jump, as the normal animal does when jumping from a wall.

Making, again, a distinction between the roof and basis of the mid-brain, removal of the roof is without effect on the locomotion. At the same time the animal can still *see*, though it appears amblyopic. Removal of the entire mid-brain does not interfere with locomotion. If the caudal portion is left in place, the tendency to motion backwards comes out far more strongly than in the frog. The removal of the cerebellum appears to be without any special effect. Finally, the removal of the anterior portion of the medulla oblongata abolishes locomotion, so that we have in this region, as in the frog, a coördinating centre of prime importance. If a specimen in this last condition have its cord severed at short intervals with scissors, it is found that when a region near the middle of the trunk is reached, the tail and posterior extremities commence what are apparently spontaneous and regular movements, which are

clearly locomotory. It would appear then that there are, in this portion of the cord, centres which were comparable to the more important centres in the medulla oblongata. In the discussion of fish, this point is brought out more clearly.

Steiner opens his study of fishes by some tests on the function of the fins and tail. The tail is preëminently the organ of locomotion, whereas the fins are used to keep the animal at a given level in the water, to steer, to stop and to move backwards; with maintenance of equilibrium they have nothing to do. *Squalius cephalus* (v. Siebold) was the fish used for these experiments. In removing different parts of the brain, the improvements in technique employed were artificial respiration, to keep the fish quiet during the operation, and a useful method of closing the wound by a gellatine cap, so that healing is facilitated and water prevented from entering the cavity of the skull. The removal of the forebrain from this bony fish (*Squalius*) is followed by no loss in locomotion. Further, the movements of the specimens are not to be distinguished from the normal, and are voluntary. When food is put in the tank it is seized by such a fish with unhesitating exactness, and a worm is distinguished from a piece of string before it is taken. Fish thus operated play together. We have here the very remarkable case of the seat of voluntary activity elsewhere than in the forebrain. Steiner argues that the forebrain once possessed these functions, but becoming degenerate (as it certainly is), parted with them to the more caudal divisions. In this fish an interbrain is not available for separate study.

As in other cases, stimulation of the roof of the mid-brain causes movements of the eyes, whereas the removal of the roof renders the fish blind. In this case the removal of the entire mid-brain has a very marked effect. Regular breathing continues, but no voluntary locomotion occurs, and equilibrium is affected. When the fish is mechanically stimulated, however, it makes locomotory movements. The cerebellum, which has really an enormous development in these fish, may be removed without causing any disturbance in the locomotion or equilibrium of the specimen. The cephalic portion of the medulla in *Squalius* possesses elevations not found in the medulla of the frog, for example. When this region in *Squalius* is removed, breathing ceases, and the animal is dead. This complication is avoided, however, when an eel is used. In this fish a section here abolishes locomotion, but leaves the breathing intact. If these observations are to be harmonized with those on the frog, the locomotor centre must be considered as somewhat variable in position, for in the fish the removal of the mid-brain produces much the same result as did removal of the cephalic portion of the medulla oblongata in the frog.

Steiner next gives his attention to *Amphioxus lanceolatus*, and by way of preface describes this creature in the normal condition as swimming only so long as is needful to hide itself in the sand, and then remaining there till it is again disturbed. Of course, where locomotion is thus reduced in the normal creature, it could not be expected that much variation could be experimentally effected. If a specimen is cut in half in the middle, the two parts, when irritated, swim independently, cephalic end first, and preserve their equilibrium. A single specimen may be cut in three or four pieces, and each piece swims alone. If the parts show signs of exhaustion, simply putting them in a bath of picro-sulphuric acid, of at least one per cent., stimulates them to remarkable activity. Steiner concludes that the body of *Amphioxus* consists of a series of equivalent metameres, each of which has its own centre for locomotion, and that there is no principle centre as in the other forms thus far studied.

The shark was next examined, the dog-fish (*Scillium canicula*) being

chiefly used. When the fore-brain was removed, and the specimen replaced in the tank, it swam about for a time, showing that locomotion was undisturbed, and then sank to the bottom, where it remained quiet for an indefinite period. The test was made to see if such a shark would feed. Though the test was continued for two months, the specimen still refused to take food. In some specimens the olfactory bulbs alone were separated, and in these the result was the same as that which followed the removal of the hemispheres. Removal of the olfactory bulb on one side only, did not interfere with the spontaneous taking of food. When the inter-brain as well as the hemispheres are removed, the *nervi optici* are cut in the operation, and the animal becomes blind, but there appears no other additional disturbance, save that the specimen tends to come to rest in a corner of the tank a trifle sooner than one which has lost merely the fore-brain. As usual, there is no observable disturbance after removal of the cerebellum, though it is rather bulky in these fish. The roof of the mid-brain is found to be a visual centre, for when removed the sharks became blind. With removal of the base of the mid-brain spontaneous locomotion is abolished, but the power remains, as appears on mechanical stimulation. There is an increased difficulty in maintaining equilibrium, despite vigorous efforts to do so. In the cephalic portion of the *medulla oblongata* is a locomotory centre; for when the brain, including this region, is removed, the power of locomotion is lost, even in response to mechanical stimulation. Continuing the observations of the spinal cord, some very remarkable results were obtained. The headless body of the shark will swim the entire length of the long aquarium, stopped only by the side wall; then, when turned about, will swim back to the place from whence it started. The relations in this case suggest that in the medulla there is some portion which acts to inhibit the spinal cord, for when this is removed the cord exhibits much greater activity. Steiner, however, takes the view that, since the cord is subordinated to the brain, that fact in the first place is additional proof of the location of a general centre for locomotion in the cephalic portion of the oblongata; and further that, since the cord is controlled, even in so slight a degree, by mere cephalic centres, it is condemned in the higher forms to lose its independence. In this connection, the spinal cord in the Rays was tested, *Torpedo oculata* being used, and it was found that, while the fish possessing only the spinal cord remained quiet when put in the water, it swam on stimulation, showing that the cord in this case, too, is possessed of locomobility, (Steiner's word, *Locomobilität*, meaning capability of locomotion).

Among the Ganoids the Sturgeon (*Acipenser sturio*) was found possessed of cord locomobility similar to that of the shark. Curious is the reaction of the lampreys. *Ammocœtes*, and the two forms of *Petromyzon*, were all observed. If one of these is cut in two in the middle, the head end makes regular swimming motions in the water, and the tail end remains quiet. When, however, the motionless part is put in the bath of picric acid, previously described, it swims in a most satisfactory manner. From this Steiner concludes that in the head end of the lampreys, there is a general centre for locomotion, and that similar centres exist in the cord also, but in this latter situation are so reduced in irritability that only some strong stimulus can bring them into action. This apparent loss of function in these cases where the function is, however, shown to be present, by the use of special stimuli is a suggestive observation. The spinal cord of the eel is excitable in picric acid, but in this animal the swimming motions are made with the caudal end of the body only, showing, as it appears, a localization of the mechanisms in that portion of the cord.

Taking up next the forced movements in bony fish, it is observed that removal of one cerebral hemisphere, or of one half the cerebellum, is

without effect, whereas removal of half the mid-brain causes circus movements towards the sound side; and a cut through one half of the medulla, rolling movements towards the operated side. In this connection some observations on the flat fishes (*Pleuronectidæ*) were made, *Solea vulgaris* being the species employed. Steiner argued that if the circus movements in the normal fish were made in the horizontal plane, and if the flat fish represented a form in which the body of the fish had rotated ninety degrees about its long axis, that if forced circus movements were established in a flat fish by operations on the brain, then the circus movements would take place in a vertical plane. Experiments showed this to be the case in a very exact way. In the sharks the result of asymmetrical removal of parts of the brain has the same consequences as in the bony fish, with the exception that injury to the interbrain, which cannot be sectioned independently in the bony fish, produces in the sharks temporary circus movements. A lesion on one side of the spinal cord would not be expected to produce forced movements; nor does it do so. Steiner concludes, therefore, that forced movements are a function of the general motor center, and such being the case, the movements themselves can be used to determine the existence of such a motor center. The next following observations are the most novel and striking which the author has obtained, and if confirmed will be an important step in our knowledge of the nervous system. If a shark which has been so operated as to perform circus movements is beheaded, the headless trunk continues to perform the same circus movements. In the case of rolling movements, beheading puts an end to them. The trunk, however, does not acquire this capability to perform independent circus movements unless at least ten hours have elapsed between the original operation and decapitation. Apropos of these observations, Steiner has something to say of memory as a function of living matter, and some criticism of apparently similar results obtained by other authors, but nothing more definite by way of explanation.

The record of experiments ends here, but there are some general conclusions and reflections on the significance of the fishes' brain. It is here that Steiner argues that, because in the shark voluntary activity is strictly bound down to the olfactory lobes, that therefore the forebrain of the vertebrates has developed phylogenetically from an olfactory centre, a conclusion that seems somewhat hasty. In discussing the genealogy of fishes from the data thus collected, Steiner takes occasion to define the brain as a general motor centre, in connection with at least one of the special senses. The spinal cord, under the control of one coördinating centre, is by Steiner developed from some ideal form composed of a series of equivalent metameres, each possessing locomobility to the same degree. When centralization of this function occurs, it takes place at the head end of the animal, but the order in which the function is lost in the spinal cord is such that it first disappears in the most cephalic portions of the cord, while it remains longest in the most caudal portion—a conclusion which has some indirect support from other sources.

Strictly considered, investigations in the functions of the semicircular canals do not follow here, but in an appendix Steiner has some interesting observations on these organs in the shark, which may thus be summarized: In *Scyllium canicula* and *Catalus*, the cartilaginous canals were opened, and the membraneous portions removed, together with their ampullæ. Whether this was done on both sides or on one side only, the result was the same, i. e., locomotion remained perfectly normal in all cases; no disturbance of equilibrium. When, on the other hand, the vestibulum is opened, and the otoliths either removed or only disturbed, locomotion becomes abnormal, the disturbance consist-

ing usually of rolling movements towards the operated side. The results in all cases are without exception. Further, removal of the semicircular canals, and filling the vestibulum with melted paraffin, cause no disturbance of locomotion or equilibrium. Since neither removal of the semicircular canals nor complete exclusion of the vestibulum, closing it with paraffin, cause any disturbance, but only mechanical stimulation of the latter gives rise to the rotatory movements, Steiner attempts to explain the disturbance as due to direct lesion of the cephalic end of the medulla oblongata, at the point of emergence of the auditory nerves. This view is very hypothetical, and the conclusion that the condition of things in the shark holds for the higher vertebrates, also has too slender a foundation to be valuable.

This lengthy notice does not touch on many smaller observations which the author has recorded, nor does it point out what is new and what old in the observations cited. So important, however, is the fundamental idea that development of function is as real a thing as development of form, and so often is the idea disregarded in biological speculation, that it has appeared worth while to give a full statement of this work of Steiner, which so well illustrates the possibilities of this line of investigation.

Histologische Studien an der menschlichen Netzhaut. PROF. KUHNT in Jena. Jenaische Zeitschrift für Naturwissenschaft, xxiv, 1. p. 177.

The investigation of Prof. Kuhnt (of which this is a preliminary notice) had two objects,—first, to determine what ones of the histological constituents belong to the tissues of support and connection, and what to the nervous elements; and second, to trace the connections of the nervous elements from the layer of fibres through to the rods and cones. He finds, contrary to the opinion of Borysiekiewicz, that the radial fibres have one nucleus only, and that the internal limiting membrane belongs to the vitreous body. He has no theory to offer as to the function of the reticular layers, but thinks that they cannot play the part of insulators, because for this purpose they would be most needed in the fovea, where they are thinnest. [May they not act as veils, to diminish the amount of light which reaches the rods and cones, and so to facilitate the concentration of the attention upon the sensations of the fovea?] In regard to the nervous parts of the retina, he was so successful as to obtain, after many failures, three good preparations showing a plain connection between ganglia of the optic nerve (ganglionic layer) and of the retina (inner nuclear layer),—which has not been accomplished before. The connecting fibre sprang, in each case, from the body of the ganglion, and not from any of the large processes, and it had only inconsiderable varicosities. Of the fibres which come from a cell of the inner nuclear layer, it is the middle one of an umbel of fibres which joins onto a cell of the outer nuclear layer. It was determined from a large number of observations, that every ganglion of the outer nuclear layer is connected with a single cone, and with a larger or smaller number of rods, according to its more peripheral or more central position in the retina. Less frequently, it was made out that a single pigment cell encloses the cone and the group of rods which communicate with a single nuclear cell. [That an arrangement of this sort must prevail, had been affirmed before by Emil duBois-Reymond, from a consideration of the numerical relations of the fibres and of the rods and cones. A cone, with a group of rods around it, all attached to one ganglion of the outer layer, ought henceforth to be called a *cone-system.*] Under the action of a given coloring reagent, not only did the color of the processes of the ganglia vary with their thickness and with their distance from the cell, but the ganglia themselves were sometimes colored throughout, sometimes only near the nucleus, only in the

nucleus, or only in the nucleolus. Whether this was owing to actual chemical differences, or to the particular condition of excitation at the moment of death of the ganglion, could not be made out. This last suggestion is a very interesting one, and invites to further investigation. In regard to one important point, we cannot help thinking that the author is very obscure. He decides against any possibility of a specific energy in the separate visual elements from the fact, as we understand him,—there are, unfortunately, no plates—that a single cell of the inner nuclear layer is connected with several cells of the ganglionic layer. In the first place, this connection would seem to be a physical impossibility, from the fact that the number of cells in the inner nuclear layer is much greater than in the ganglionic layer. In the second place, absolutely nothing is said about the multiplicity of the connection between the inner and the outer nuclear layer. In the third place, is it quite certain that several different fibres may not preserve their continuity on going through a single ganglionic cell?   C. L. F.

On the morphology of the compound eyes of Arthropods. S. WATASE. Studies from the Biological Laboratory, Johns Hopkins University, Baltimore. Vol. iv, No. 6, 1889. Plates XXIX—XXXV.

The author has made both a careful and extensive study of his subject. The paper opens with "a consideration of the *ommatidium* as the morphological unit of the compound eye in arthropods, just as each little circle of rods with a cone in its centre may be considered as the morphological unit of the 'mosaic layer' (Henle) of the human retina." The *ommatidium* in *Serolis*, which is first described, presents three strata of cells. The most superficial is designated *corneagen*, the next the *vitrella*, and the deepest the *retinula*. This last alone is sensory. Each of these cells secretes chitin or a chitinous substance on what is morphologically its outer surface. The cells are, therefore, homologous with the ectodermal cells covering the surface of the body, and the *ommatidium*, with its various specializations, is morphologically a pit in the ectoderm. With *Serolis* as a type, the *ommatidia* of *Talorchestia, Combarus, Homarus* and *Calinectes*, and a number of others, are found to agree in all essentials. The compound eye of *Limulus* is next described, and the very primitive conditions found in this ancient form are in harmony with the previous observations. The pits in *Limulus* are much less complete than in the other forms described, and the dioptric apparatus less perfect. In discussing the compounding of an eye from these *ommatidia*, the anatomical point is made that the nervous prolongations of the *retinulæ* first form an intricate plexus, and then take their course to the optic ganglia. From the physiological side, it is pointed out that all vision is punctate, whether it be the vertebrate or invertebrate eye which is the organ; and therefore, in considering the vision of a given arthropod, its fineness is measured to some extent by the size of the individual *ommatidia*, whereas the range depends on the number of these units, and the manner in which they are distributed, exposure of *ommatidia* over a spherical surface giving an eye with the widest range. In an appendix, it is stated that the eye-spots in *Asteridæ* agree in their essential structure with those of the arthropods. The paper contains much more of interest, which is, however, not in place here, but which helps to make it a most valuable contribution to our knowledge of the sense-organs.

On the descending degenerations which follow the lesions of the Gyrus marginalis and the Gyrus fornicatus in Monkeys. E. P. FRANCE. With an introduction by Professor Schäfer, F. R. S. Phil. Trans., vol. 180, (1889) B. pp. 331–354. 3 plates.

The brains used in this investigation were from animals that had been employed for physiological experiments by Prof. Schäfer, in conjunction

with Prof. V. Horsley and Dr. Sanger Brown, so that a complete record of the symptoms during life was available. Removal of the *gyrus marginalis* has been found to produce paralysis of the trunk muscles and most of the leg muscles on the side opposite to the lesion. France had at his disposal six cases of lesion to the *gyrus marginalis*. In two the injury was strictly confined to this gyrus, while in the remaining four there was some injury to the adjacent external surface of the hemispheres, or to the *gyrus fornicatus*. A summary of these shows the degeneration as difficult to detect in the internal capsule—all that can be said is, that it has not been observed, frontad of the knee of the internal capsule. At the level of the pons, the degeneration was scattered through the pyramidal bundles. In cases where the lesion had been extensive and the animal had lived for some time, the mass of fibres on the side of the operation was plainly less than on the other side. At the level of the *medulla oblongata*, the degeneration appears in the pyramids, and is more condensed than in the pons. The pyramid on the operated side is smaller at this level also—under the same conditions which determined a difference in size in the pons. In the spinal cord, the degeneration is mainly in the crossed pyramidal tract of the side opposite that of the lesion, and to a much less extent in the crossed pyramidal tract of the same side. In some cases it may be traced as far as the lower lumbar region. Degeneration of the direct pyramidal tract has not been observed on either side. Throughout the cord, the degeneration is most evident in the dorsal and lateral portions of the pyramidal tract, and this location appears characteristic for the lesion which it follows.

In the study of those degenerations, consequent on lesions of the *gyrus fornicatus*, six brains were examined, from which a part or the whole of this *gyrus* had been removed. During life it was found that stimulation of the *gyrus fornicatus* produced no muscular contractions, and that when it was excised, the slight paralysis which sometimes appeared was no more than could be accounted for by the almost unavoidable injury to the *gyrus marginalis* lying above it. On the other hand, its removal caused a well-marked deficiency of general and tactile sensibility over the opposite half of the body. For this lesion, the course of degeneration in the internal capsule could not be made out with any certainty. In the mid-brain, pons and medulla, the degeneration appears like that following marginal lesions, and is found only in the pyramidal bundles on the same side as the lesion. In the spinal cord, the degeneration occupies the whole sectional area of the crossed pyramidal tract, mainly on the side opposite to the lesion, but in part on the same side It may be traced caudad to the level of the fifth lumbar nerve.

In an appendix appears a study of the degenerations which follow the removal of the external motor cortex and of the whole motor cortex of one hemisphere in monkeys, as compared with those which follow lesions of the *gyrus marginalis* alone. In three cases of the removal of the external motor surface of the brain, the animal having lived for some time subsequent to the operation, the resulting degenerations were similar to one another. In the internal capsule the degeneration is well marked. It occupies the middle third of the capsule, and therefore includes the knee, but is confined to the layer of fibres adjacent to the lenticular nucleus, leaving a thin layer which is normal, towards the thalamus. At the other levels it is as follows: *Crusta*: Degeneration clearly defined; occupies middle third, the dorsal part being less completely degenerated than the ventral. *Pons*: Degeneration involves the entire pyramid, on the same side, almost all the fibers being degenerated. *Medulla*: Whole pyramid of the same side is degenerated, except a narrow portion of the dorsal and mesal tract which is less affected. *Spinal cord*: The degeneration is in the crossed pyramidal tract, the portion bordering on the direct cerebellar tract being less affected. It may be followed to the lower lumbar region. In four cases, the *entire*

motor area was removed from one hemisphere. The entire motor surface comprises the region just described in the previous cases, plus the *gyrus marginalis*. The degenerations observed were quite similar to those described as following the removal of the external motor area, except that they were more complete. In the internal capsule, the degeneration includes the layer adjacent to the optic thalamus. In the crusta and pons it was more complete. In the medulla the pyramid was entirely degenerated, and in the spinal cord the entire crossed pyramidal tract was degenerated, the part bordering on the direct cerebellar tract as completely as the rest. The degeneration passes to the level of the fourth lumbar nerve. So far as these results bear on the *gyrus marginalis*, they show the plus of degeneration in this last group to be equivalent to the entire degeneration where this gyrus alone is destroyed, the two sets of observations thus harmonizing in a satisfactory manner. No definite statement is made in the appendix concerning the side of the cord in which the degeneration of the crossed pyramidal tract occurs. It is to be presumed, however, that the bulk of degeneration is on the side opposite to that of the lesion, while to some extent it occurs on the same side. No degeneration has ever been observed in the anterior columns of the cord in the monkey, and from this the author concludes that the decussation at the pyramids is complete. Since, however, the degeneration occurs in both crossed pyramidal tracts, it would seem to indicate that though no pyramidal fibers found their way to the anterior columns, yet the crossing was incomplete. Aside from the interesting point that the dorsal and lateral portion of the crossed pyramidal tract contains the bulk of the fibers from the *gyrus marginalis*; that these same have a distinct path through the internal capsule and other portions of the axis; and that there is no degeneration in the anterior columns of the spinal cord, there is the very striking result that the *gyrus fornicatus*, which is not connected with motion, but is connected with sensation, causes, on its removal, a descending degeneration, and that this degeneration follows the path of the crossed pyramidal tracts. As Schäfer points out, it is very difficult to bring this degeneration with such a direction and track into harmony with the current views of the relation of the nerve fiber to the cell, and the direction in which degeneration of sensory fibers takes place. The solution of the contradiction is left for further investigation.

(In the rabbit, at least, and probably in man, the cerebral cortex is represented in the thalamus, a portion of the thalamus degenerating in correspondence with the part of the cortex removed, e. g. primary optic centers. This gives the motor cortex at least a double connection with the lower centres, and though these fibers degenerate from above downwards, there is much reason to consider them as sensory, and the results obtained by France from the study of the *gyrus fornicatus* serves to increase the probability of such a view. REV.)

On Neurokeratin. W KÜHNE and R. H. CHITTENDEN. New York Medical Journal, Feb. 22 and Mar. 1, 1890.

In the first paper, Neurokeratin is defined as the constituent of the peripheral and central nervous systems, which is insoluble in alcohol, ether, gastric and pancreatic juice, and dilute caustic potash. The substance was first described by Kühne some thirteen years ago, and since that time has been much discussed by histologists, its existence being doubted by some, while certain parts of the nerve fiber were by others identified with it, one argument against it being that it was an artefact developed by the action of the alcohol and ether. That objection seems now to be answered by the fact that it can be equally well obtained, whether the specimen be first treated with alcohol and ether

and then digested, or the order be reversed.   Five analyses were made.
No. 1, for example, gives:

C.,	56.11
H.,	7.33
N.,	14.32
S.,	1.88
Ash.	1.21

Neurokeratin, therefore, does not contain phosphorus; and sulphur is
the most variable constituent, the percentage in one analysis reaching
2.24.   Compared with keratin from the hair of a rabbit, it also shows a
decided difference in composition, principally in sulphur, which
in the keratin, reaches 4.02.   An interesting point is, that the
examination of the central nervous system of the lobster showed the
analogous insoluble substance to consist of chitin.   A study of the
quantitative distribution of neurokeratin shows the white matter of the
brain to be richest in it, and to have some nine times as much as either
the gray matter or the peripheral nerves.   The second contribution
treats of the histological detection of neurokeratin, pointing out some
of the differences between the frog, fish and mammals (rabbits), and
concluding that the double sheath joined by cross bands which is found
after the treatment of the nerve fibers, represents the neurokeratin
framework of the sheath of Schwann, the axis cylinder sheath and the
medullary substance.

(The paper is very valuable from the full descriptions of all methods
used—something which was much needed.   The statements as to the
structures which may represent the neurokeratin in the cortex, and the
white matter of the central nervous system are, however, suggestive
rather than conclusive.   REV.)

*Ueber eine neue Färbungsmethode des centralen Nervensystems und deren
Ergebnisse bezüglich des Zusammenhangen von Ganglienzellen und
Nervenfasern.*   PAUL FLECHSIG.   Archiv f. Physiologie, Heft 5 und
6, 1889.   1 Tafel.

The plate accompanying this short communication is very instructive·
The difficulty with the cells, as brought out by Golgi's method, has been
heretofore that no connection between them and the medullated fibers
was demonstrated.   In this case, specimens treated by Golgi's bichloride
of mercury method were further treated with an extract of Japanese
redwood, ("*Japanischer Rothholz*"—further information as to what plant
is meant by this commercial term is not given).   For the details of the
method, which is complicated, the reader is referred to the original.   By
the treatment the nerve fibers are all colored red, the cells and their
prolongations being black, and where the prolongation of a nerve cell
goes over into a nerve fiber, it can in these specimens often be followed.
The tissues investigated were bits of human cortex from about the
central and the calcarine fissures.   The general conclusions arrived at
were: 1.   That the protoplasmic prolongations were not found in con-
nection with nerve fibers.   2.   The axis cylinder in most cases
branches; it often forms a T, similar to that of the cells of the spinal
root ganglia.   These branches of the first order may divide again,
forming as many as eight subdivisions.   Such cells are only from the
calcarine region.   There is, therefore, a marked distinction between the
methods of branching in the two regions examined.   3.   The fine net-
work formed by the subdivision of the axis cylinder of cells of the
second category (Golgi, Nansen) is not brought out by this method.   4.
The fibers forming the superficial and middle horizontal plexuses in
the cortex arise from neighboring cells by branches that leave the axis
cylinder at right angles.

Ueber ein neues Opticuscentrum beim Huhne. DR. PERLIA. Archiv für Ophthalmologie, Bd. xxxv, Abth. i, 1889. 1 Plate.

Upon studying in the chick the degeneration which follows the removal of one eye, Perlia finds, besides the usual degeneration of the contralateral tractus, a bundle of fibers which separates from the tractus at the ventro-lateral angle of the interbrain, and passes first dorsad then caudad along the mesal margin of the optic lobes, finally terminating in a large nucleus which lies laterad of the trochlearis nucleus, and is at least twice the size. The ganglion appears to connect with the *lobus opticus*, with the motor nuclei, and with the ventral portions of the axis. This bundle and its nucleus degenerate when the optic tract degenerates. Pending further work on its function, Perlia designates this as the median optic bundle, and makes the plausible suggestion that it will be found connected with the pupillary movements, which are so well developed in the bird.

Die Formentwickelung des menschlichen Vorderhirn von Ende des ersten bis zum Beginn des dritten Monats. WILHELM HIS. Abhandl. d. Mathemat.-phys. Cl. d. Königl. Sächs. Gesellschaft d. Wissenschaften. Bd. xv. Leipzig, 1889. 1 Plate.

This, the most recent paper by His on the development of the nervous system, is well supplied with cuts, and has, moreover, one plate of very unusual excellence in every way. The text is mainly a description of the contained figures, so that it cannot be given in abstract, save in a very incomplete manner. The immediate object of the paper is to give the topography of the first appearances (*primäre Anlagen*) of the different portions of the encephalon; only in the case of the olfactory lobe does the author enter into histological details. He opens with a discussion of the axial flexures of the mid and forebrain. Under the head of primitive longitudinal divisions of the mid and forebrain, His maintains that the division of the lateral half of the neural tube into a dorsal wing-plate (*Flügelplatte*) and a ventral basal-plate (*Grundplatte*) is recognizable not only in the region of the myelon, where he has already described it, but that it is continued cephalad to the extremity of the primitive forebrain. The line of demarcation between these two plates follows the flexures, as illustrated by the brain of *Ammocoetes* and that of a salmon embryo. This line terminates at a point just cephalad of the chiasma; and the optic tract, running as it does for some distance at the junction of the two plates, behaves like the ascending root of the other sensory cranial nerves.

The optic vesicle represents substance taken from the wall of the neural tube, and it is of great importance to determine from which of the above mentioned plates it may be derived. His decides that the main portion, and at least all that which forms the retina, comes from the basal plate. He is doubtful concerning the pigment layer alone, which may, in part, arise from the wing-plate. Morphologically, then, the retina is homologous with the anterior cornua of the spinal cord, and the region of the motor nuclei in the hind and mid-brain. This striking result puts the retina by itself, and separates it from all the other sensory organs thus far described. In speaking of the formation and protrusion of the optic vesicles, His holds to the mechanical explanation for the former, and goes into the anatomy of the region in the embryo in much detail. In the first stages the optic stalk enters the optic cup eccentrically, the point of union lying ventrad of the centre of the cup. With the change in the position of the eye, as development proceeds, the bulbs move cephalad and mesad, the change of position taking place in such a manner that the junction of stalk and cup becomes mesal. The optic nerve fibers follow the line of the optic stalk. It thus comes about that the eccentric insertion of the optic nerve in

the retina of the developed eye is a consequence of the similar relation of the stalk to the cup in the embryo.

When the hemispheres commence to develop, it is not until the end of the fourth week that they are at all divided into right and left, and the first indication of division is, curiously enough, a longitudinal ridge in the parietal region. A careful description of the development of the forebrain region, including the plexuses, *corpus striatum*, and the divisions of the interbrain, finally brings the author to a description of the olfactory region. The condition in the embryo is prefaced by a study of the region in the adult. Starting here from the bulb, and passing caudad, the olfactory tract splits into a median and lateral root. These first enclose the *trigonum*. Caudad of this, and separated from it by the *fissura prima*, is a roughly quadrilateral field, a portion of the anterior perforated space, which is bounded laterally by the lateral root of the tract, and mesally by the *gyrus subcallosus* (peduncle of the callosum). This region is the quadrilateral space of Broca. There is another small region lying in the mesal surface, and bounded by the *fissura prima* caudad and the *fissura serotina* frontad, and this His names "Broca's region." In discussing the olfactory lobe in the embryo, His divides it into a cephalic and caudal portion. The cephalic lobe in man gives rise to the bulbus, tractus, trigonum and Broca's field—to the caudal lobe belongs the *gyrus subcallosus* and the quadrilateral space. Where the bulbus comes to overlie the nose region, there is developed over a region of thickened nasal epithelium a true olfactory ganglion, consisting of bipolar nerve-cells, such as are found in the posterior root ganglia of the spinal cord. This ganglion appears first in embryos about 11 mm. in length. In the adult, the ganglion contributes the fiber and glomerular layers, the other portions of the bulbus being an outgrowth from the brain. This discovery, which brings the olfactory nerve in man into line with the typical sensory nerves, is a most welcome one, but the retina still remains, according to His, as much of a problem as ever. For the many other points of value, the reader is referred to the original.

Recherches sur les terminaisons des nerfs dans les disques terminaux chez la grenouille (Rana esculenta, Rana temporaria). J. FAJERSZTAJN. Arch. de zool. exp. et gen., 2d série, T. VII, 1889, p. 705—750, pls. XXXIII et XXXIV.

The author discusses at great length the conflicting results and opinions of Waller, Leydig, Billroth, Fixsen, Hoyer, Key, Hartmann, Engelmann, Merkel, Krause, and Holl. The memoirs of Beale and Maddox, on the arrangement of the nerves in the papillæ of the frog's tongue, were inaccessible to him. For fixing agents, in the present investigation, the best results were obtained with bichloride of mercury (5 to 100), Flemming's solution, and Carnoy's solution. The hardened tissues were imbedded in paraffin and in celloidin, preference being given to the latter. The cells of the disc were teased in a mixture of bichromate of potassium 4 to 100 + 1 to 100 of hydrate of chloral. A weak solution of. eosin and iodine-green stained the cell nuclei green and the plasma of the cells red. For coloring the nerve terminations methylene blue, injected into the living animal according to Ehrlich's method, was mainly employed. Near the summit of the fungiform papillæ, and just beneath the end-discs is a "basal membrane," the *Nervenschale* of Key, *Nervenkissen* of Engelmann. Fajersztajn describes four kinds of cells in the end-discs, viz.: cylinder, winged, forked, and staff-shaped. The cylinder cells (*Cylinderzellen*, Merkel, Schwalbe, Holl) correspond to Key's modified epithelial cells, Engelmann's *Kelchzellen*, and Leydig's *Geschmackszellen*. Their central processes are very irregular and most difficult to follow. They reach the basal membrane, where they appear

to intersect with the processes of the other cells. The winged cells (*Flügelzellen*, Merkel) have only been found in batrachians. Leydig mistook them for cylinder cells, while Merkel looked upon them as merely representing a stage in the development of those cells. Their central processes pass between the cells of the disc and pierce the basal membrane. The forked cells (*Gabelzellen*, Engelmann), considered by Merkel artificial products, were found but rarely. They possess very long, varicose central processes, there being always two to four of these processes to a cell. The processes perforate the basal membrane, where they ramify freely and form a plexus with the central processes of the winged and staff cells. Two forms of staff cells are described. The first form corresponds to Key's *Geschmackszellen*, Engelmann's *Cylinderzellen*, and Merkel's *Stützzellen*. The second form is marked by a very short central process. These cells are doubtless Merkel's *Stäbchenzellen*, although no cilia were detected on their free extremity. Merkel looked upon these cells as constituting the sensory elements of the disc. Fajersztajn, however, does not so regard them. He agrees with Engelmann in considering the forked cells as the true sensory cells; but as to whether they are specifically gustative or specifically tactile he does not venture an opinion. Beneath the basal membrane is a plexus formed of non-medullated nerve-fibrils, which the author terms the "*plexus subbasalis.*" From this plexus fine varicose fibrils enter the basal membrane, where they ramify in all directions. Some of these fibrils traverse the membrane and penetrate the epithelium, forming beneath the bed of nuclei of the staff cells an exceedingly compact network. From this subepithelial network very delicate varicose fibrils pass between the cells of the disc and reach its free surface, where they terminate in bud-like enlargements. Where and how the fibrils terminate which do not reach the free surface of the disc Fajersztajn is unable to say. He believed in the contiguity, but not in the direct continuity, of nerve-fibrils and the central processes of the sensory cells. Contiguity, he suggests, may be effected either by the terminal buds applying themselves to the bodies of the sensory cells, or by the central processes of those cells adhering closely to the nerve-fibrils of the subepithelial plexus.   F. T.

Within a short time the writer of the present note published the results of some studies touching the development of the gustatory organs of man, and at the same time offered a few suggestions as to the nature and probable mode of origin of these terminal structures. (*Journ. Anat. Phys.*, xxiii, 1889, pp. 559–582; xxiv, 1889, pp. 130, 131.) The earliest tongue investigated was from an embryo of about the tenth week. In this specimen the gustatory papillæ were wholly undeveloped, nor was it possible to determine with any degree of certainty their future position. In the next tongue examined, that of an embryo of the fourteenth week, the dorsal surface was more or less marked by papillary elevations of the mucous membrane. The elevations varied greatly in size and shape, and the spaces between them were filled for the most part with epithelium. The epithelial covering of the elevations had an average thickness of about 0.024 mm., and was composed of three somewhat indistinct layer. The superficial layer consisted of slightly flattened cells, which, at its deeper part, became blended with those of the middle layers. The middle layer was much thicker than the preceding, and was composed of nucleated spheroidal or polyhedral cells. Below this was a deep layer consisting usually of a single row of columnar cells. The mucosa was very rich in nuclei, and, at short intervals, was penetrated to a considerable depth by the proliferations of the epithelium. These proliferations of the epithelium are of interest, as indicating the future position of the glands and their ducts.

The striped muscle-fibres of the tongue were clearly shown, but their striæ were exceedingly faint. Several papillæ of the circumvallate type, in the early stages of development, were present. The trenches, however, were undifferentiated, although their future position was clearly indicated. Fungiform papillæ, in various stages of growth, were scattered over the dorsum, and at the sides of the back of the tongue the lateral gustatory organs were sufficiently advanced to be perceptible. A few taste-bulbs were detected in the circumvallate papillæ of this embryo, but, unfortunately, little could be learned of their structural details. The best marked bulb was spheroidal in shape, and resembled, in some degree, those of the soft palate and epiglottis. It was placed vertically in the long axis of the papilla, with its lower two thirds resting in a cavity of the mucosa. On the tongue of a fœtus, at the fourth month of intra-uterine life, were five papillæ of the circumvallate type. One of the smaller of these papillæ bore on its exposed surface a taste-bulb in an early stage of development. This bulb measured 0.0165 mm. in length, and 0.012 mm. in breadth, and was largely subepithelial in position. The tongue of a fœtus at the middle of the fifth month showed circumvallate papillæ in process of transition from the fungiform type. The greater number of the circumvallate papillæ, and also many of the fungiform papillæ bore embryonic bulbs on their upper surface. The more advanced among them were mainly epithelial in position, while the less mature were largely imbedded in the stroma of the mucosa. Medullated nerves were fairly shown in these papillæ. Directly beneath the basal cells of the epithelium was a fine, delicate, reticulated network, from which non-medullated nerve-fibrils passed upwards, penetrating the bulbs and neighboring epithelium. On the tongue of a six months' fœtus the trenches of the papillæ were for the most part differentiated, and a few immature bulbs were detected on their lateral area. In the lateral organs of taste the furrows were quite free from epithelium, save at their lower part, and bulbs were scattered over the upper surface and sides of the folds. In a fœtus at the seventh month, the bulbs had increased greatly on the lateral area of the gustatory papillæ, and there was no apparent decrease in the number of those on the free surface. In a child about a month old the bulbs were quite uniformly disposed at the sides of the papillæ, those of the lower tiers being less regular in arrangement and smaller, and lying partly in the mucosa. In a child four months old, isolated bulbs still occurred on the free upper surface of the papillæ of both gustatory areas. In the circumvallate papillæ of the adult, the bulbs did not appear to have decreased in number, but they had disappeared almost completely from the upper surface. In the adult papillæ foliatæ they were far less numerous than in early life, but were still normally present on the upper area of the folds.

What purpose the temporary taste-bulbs (for such they appear to be) of the free upper surface of the circumvallate papillæ subserve in the embryo, is difficult to comprehend. With the appearance of the bulbs of the lateral area, they gradually disappear, and, from all indications, perish. By the time the bulbs of the free surface of the papillæ have attained their full development, bulbs in early stages of formation make their appearance on the wall, the lowermost bulbs being the most elementary. Were it otherwise, it might be conceivable, as Hermann suggests, that by an unfolding of the papillæ laterally, the bulbs of the free area are shifted to the sides. In the present state of our knowledge, there seems to be no better way than to believe, with Hoffmann, that "the bulbs of the free surface perish through the proliferation of the ordinary epithelium." It is not improbable that, after the bulbs have once disappeared from the upper surface, certain altered condi-

tions of the epithelium prevent, save in rare instances, their recurrence there.

Before concluding this brief summary, the earlier investigations of Hönigschmied, Hoffmann and Lustig should be mentioned. Hönigschmied, in a communication on the microscopic anatomy of the taste-organs (*Zeit. f. wiss. Zool.*, xxiii, 1873), merely remarks that he failed to detect in the circumvallate papillæ of the new-born child any regular arrangement of the bulbs. Hoffmann (*Virchow's Archiv*, lxii, 1875) investigated the human embryo and new-born child for the purpose of studying the distribution of the taste-organs in man. In a fungiform papilla of a four and one half months' fœtus, and also in the papillæ of one at the sixth month, he found taste-bulbs, but he failed to detect them in earlier embryos. He concludes that they are more frequent in embryos and in newly-born than in older individuals; that in embryos and new-born children they occur more frequently and in greater number on the free surface of the papillæ than in the adult, and that in old persons they are but rarely met with in this region. Lustig (*Sitzb. d. k. Akad. d. Wiss. Wien*, lxxxix, iii, 1884) failed to detect bulbs in the papillæ of a fœtus at the end of the fifth month, but in one at the seventh he found them on the free upper surface of both circumvallate and foliate papillæ. While taste-bulbs were wanting in the tongue of a ten weeks' embryo, it is not improbable that they may yet be found in the incipient stages of growth in one of the twelfth week of intrauterine life. F. TUCKERMAN.

II.—EXPERIMENTAL.

Ueber die Theorie des simultanen Contrastes von Helmholtz. E. HERING. Four papers in Pflüger's Archiv, Vols. 40, 41, 43.

I. *Die farbigen Schatten.* Helmholtz considers that the experiments with colored shadows show conclusively the influence of the judgment in producing simultaneous contrast. Hering, by more careful experiments, makes it plain that this is not the case. He makes the usual arrangement for colored shadows, the sources of light being day-light and a gas-flame, and the tube being arranged so that it can be instantaneously split open. The tube is so directed that the observer looks half upon the gas-lighted paper and half upon the blue shadow, complete fixation being made easy by a dot in the middle of the line of separation. To facilitate reference we shall call the shadow half of this field *s*, and the gas-lighted half we shall call *g*. After everything is in position, the gas is lighted, and *s* instantly becomes blue and *g* yellow, the yellow being an objective color and the blue subjective. Whether that subjective blue is physiological (in the retina) or psychological (in the judgment) is the question at issue.

The next step in the experiment is to move the shadow-throwing prism so that the tube looks wholly upon its shadow. Under these circumstances, according to Helmholtz, the whole field of the tube is blue, and this shows that the effect is due to the judgment; what one has just judged to be blue one still judges to be blue, and other reason for seeing this blue there is none. But as matter of fact, if the fixation has been careful, *it is not true* that the whole field of the tube is now blue; on the contrary, *g* is blue, but *s* is a distinct grayish-yellow. The blueness of *g* is now easily accounted for,—it is simply the complementary fatigue-color to the former yellow gas-light. Hence there is no occasion to say anything about the persistence of the judgment-error. But what is the cause of the yellowness of *s*? If the former blueness of *s* was physiological—a spreading over of the yellow-excitation, as Hering believes—then it, too, is due to fatigue. But it is still possible

at this stage, as it seems to the reviewer, that the color of *s*, both in the first and in the second phase of the experiment should be due to judgment contrast.

There is a third phase to the experiment, however; the gas is extinguished and the tube is suddenly opened. Helmholtz says that everything now appears of a natural white. But in fact, if one looks carefully, one can still see a circular spot, the field of the tube, the colors of both *s* and *g* being very much the same as in the second phase. This after-image persists longer, the longer the first phase and the shorter the second phase have lasted. There is no difficulty in getting it, even without the self-opening tube. It was overlooked by Mr. Delabarre, who has repeated these experiments, and who says, "If . . one lay aside the tube and glance at the field the color at once disappears." (This *Journal*, Vol. II, p. 641).

This after-image lasts a much shorter time, of course, than that in the second phase. Its occurrence seems to the reviewer to render it certain that a mistaken judgment is at least not the principal cause of the whole phenomenon. It is incredible that a mistake should extend itself over a small semi-circular spot and no farther.

II. *Der Contrastversuch von H. Meyer und die Versuche am Farbenkreisel.* Hering first calls attention to the fact that he, too, lays great stress upon the effects of experience and of practice, as is shown in his *Gedächtniss als eine Function der organischen Materie*, and that if he does not agree with Helmholtz in explaining simultaneous contrast as an effect of the judgment it is simply because the facts seem to point, in this case to a different explanation. In order to show that simultaneous contrast is due to the judgment, Helmholtz endeavors, in all cases where the sensation is a strong one, to so vary the circumstances as to make it weak, or evanescent; for instance in Meyer's contrast-experiment he shows that if the grey ring is held in front of the colored paper so as to be plainly distinct from it in space, its color vanishes. But Hering points out that *actual* slight-differences in color are easily made to vanish by slightly varying the circumstances. A feeble after-image which one can easily see on a smooth surface will quite fade out on a rough one. A slight difference of color of two papers is overlooked if one is smooth and one rough, or even if they have a different grain, and they are so held that the grain is perceptible. A black mark around one will also destroy the difference. On a color-top, all unevennesses of surface disappear and a color is seen in its ideal state. But a bit of paper of exactly the same color as the top, when held in front of it, will look different. Even if the paper behind is not rotating, one cannot be sure that the one in front is of the same color, so long as there is a difference of brightness, or a distinct edge, and all the more if one cannot accommodate for both at once. If the lighting is as near as possible alike, and if the accommodation is for neither (so that the edge becomes indistinct) the observer may think the colors alike, but he may also actually fail to see that there are two different papers, however much he knows that there are two. Fixate a bit of paper in front of a ground of the same, but shove in between them a black cardboard for a few seconds; then remove suddenly both the card-board and the bit of paper. A spot appears on the ground, which is of different color from that, and which is also perceived to be a different color from the just-removed bit. In other words, a separate bit, *seen to be such*, forms a hindrance to perceiving a slight amount of difference. But this is a case of an *after-image* being far less perceptible on the scrap of paper itself than on the large sheet; and Helmholtz himself would not say this proves the psychological nature of *after-images*. No more should a similar fact be taken, then, to prove the psycho-

logical nature of simultaneous contrast. This experiment has been varied by the reviewer by having two dots on the scrap of paper, and fixing first one, and after the black card-board is removed, the other. In this way the after-image of the scrap falls in part on the scrap itself and in part on the paper underneath, and the two colors can be compared at leisure. In this case, *no difference can be detected* in the two colors, other than what is due to some unavoidable difference of brightness. But Hering might reply that in this case, the after-image, even where it falls on the scrap, is taken to be a distinct object, and not a simple color of the scrap of paper.

These considerations remove the force from most of Helmholtz' arguments in favor of judgment as a cause of simultaneous contrast. Hering denies that the brightness of the contrast-color does not increase with the saturation of the inducing field, but his experiments in another paper (Pflüger's Archiv, XLII, p. 119. See this *Journal* I, 706) are more conclusive on this head. This point is important, because the opposite fact is considered by Wundt to be the chief objection to the whole theory of Hering (Phil. Studien, IV, p. 312.)

III. *Der Spiegel-contrastversuch.*

In the experiment of Ragona Scina, a vertical and a horizontal sheet of white paper have one edge together and a colored glass plate forms an angle of 45° with each. Instead of small black squares on the sheets of paper, Hering uses concentric black rings. One ought to see a mirrored vertical ring green (using green glass), a horizontal one white, and the space between them a mixed whitish green, but the white one is by contrast red. If the brightness of the whole is properly regulated (it is enclosed in a chest), the success of the experiment is surprising, the red is quite as saturated as the green. Helmholtz' explanation is that since we suppose the greenness of the plate to be uninterrupted, a spot which really looks to us white we fancy to have a red spot underneath it, because it would take a red spot under a green glass to *look* white. This explanation assumes an extraordinary power on the part of the observer in picking out complementary colors; it is completely vitiated by the fact that the red color is as distinct as ever when, by a proper framework, the green plate is made perfectly invisible, and to a fresh observer who is quite unaware that there is any plate there. Moreover, by moving the sheets of paper (and so making the rings not quite concentric) the green rings may be made to seem in front of the red, or the red in front of the green, at pleasure. The red and green rings seem to swim in a whity-green space like birds in a blue sky. According to Helmholtz, a bit of white paper held evidently in front of the green cloud does not look red; but according to Hering, if it is fine-grained, and if the color and brightness are exactly the same, it looks quite as red as the other, even though it be made to swing in front of the glass plate and be looked at binocularly, and this whether the glass-plate is visible or not. In this, as in every case of simultaneous contrast, the color is very fleeting if successive contrast is carefully shut off by means of fixation. It quickly passes over into what Hering calls the "simultaneous induced" color, which is the same as that of the inducing field. [This name is very bad, because it does not distinguish the thing from the simultaneously induced opposite color. There is a great need of a new terminology for contrast, to take the place of the both cumbrous and inexact one which is now in use. Helmholtz frequently uses *contrast* alone, when it is impossible to find out by the context whether he means simultaneous contrast or successive contrast. The following may be proposed. In the first place, there is no reason why we should not say *co-color* instead of *complementary color*, as we have long said *cosine* instead of *sine of the complementary angle*. We might then have for the four things to be named :

1. Induced co-color (brief, and, if there is fixa-
tion quickly passing over into)   } if Hering is right.
2. Induced self-color.

1. Judgment co-color.
2. Spread self-color (Physiol. Optik, p. 400.)   } if Helmholtz is right.

3. Positive after-images.
4. Negative after-images   } in both cases.

(1) and (2) are occurrences in the immediate vicinity of the original impression, (3) and (4) are occurrences in the same place. REV.]

IV. *Die subjective " Trennung des Lichtes in zwei complementäre Portionen."*

Helmholtz is of the opinion that our unconscious experience causes us, under certain circumstances, led by unconscious false judgment, to separate an actual white sensation into two components, and to deceive ourselves into thinking that we see one of these components only. This hypothesis is used by Helmholtz to explain many cases of color-contrast. Hering has already given reasons for not adopting it, and more follow in this article. It presupposes, for one thing, an acquired unconscious knowledge of what colors are complementary which is totally wanting in our conscious store of knowledge,—a rather violent supposition, and one which could only be accepted if colored veils and mists and glasses had been much more common in the experience of our remote ancestors than there is any reason to suppose that they have been. Helmholtz considers that it is easily possible, when an object is seen through a colored screen, to decide what part of the mixed color perceived is due to the screen and what to the object. Hering shows that when proper precautions are taken this is an absolute impossibility. An observer, provided with a tube, looks through a thin colorless glass plate and sees a transmitted image of a piece of colored paper behind the glass with a reflected image of a smaller, differently colored piece of paper from in front thrown upon the middle of that. If the front and back papers are equally distant from the glass plate, the two objects seem like one; if either is moved, one is seen to be plainly in front of the other, since they are looked at binocularly. But in either case, *the color of the combined images is the pure color of the mixture*, there is not the slightest tendency to separate it up, subjectively, into the two colors of which it is really composed, provided that all the proper precautions have been taken in preparing the experiment, although it is impossible not to perceive that one object is seen through another.

Hering promises, at the end of this communication, another, in which he will speak of general considerations having a bearing upon Helmholtz' theory of simultaneous contrast.   C. L. F.

Sur la vision des couleurs de contraste. D. AXENFELD. Archives italiennes de Biologie. Vol. XI, part 1, Jan. 1889. Extract from the Bullettino della R. Accademia medica di Roma, An. XIV, 1887-88, fasc. 7.

Axenfeld gives an improvement on Ragona Scina's method of producing color-contrast. In front of a source of light he puts a screen with holes in it, and allows these holes to mirror themselves in a plate of colored glass. The images from the front and the back surface of the glass show complementary colors. For binocular color contrast, he produces double images of a black square on white paper, one eye looking through colored glass and the other not. He is of the opinion that the contrast-appearances due to light penetrating through the sclerotic coat are not produced by fatigue, since they appear instantaneously. He attributes great weight to the fact that one of the colored surfaces seems, in all these cases, to be transparent, and hence he concludes that the psychological part of the explanation cannot be entirely dispensed with. In general, he accepts Hering's color theory.

Ueber die von v. Kries wider die Theorie der Gegenfarben erhobenen Einwände. E. HERING. Pflüger's Archiv, XLII, u. XLIII.

I. Following out the mathematical discussion of the conditions of color-mixtures which he gave in his *Newton's Gesetz der Farben-Mischung*, Hering replies in detail to v. Kries' objection that when more than three fundamental colors are assumed color-mixtures which look alike at one degree of fatigue do not necessarily look alike at a different degree of fatigue. The objection of v. Kries is based upon the assumption that the three distinguishable qualities of a given color-mixture (tone, intensity and saturation) give rise to three equations expressing respectively the identity of the same function of three processes when the processes are modified by different fatigue co-efficients. Three equations involving *three* unknown quantities (the fundamental processes) suffice to determine those unknown quantities but not if they involve more than three. To this Hering very properly replies (overlooking the arbitrariness of the original assumption) that it is not necessary that the colors should *necessarily* look alike, but that it is sufficient that one of the many possible solutions of the equations should *permit* them to look alike, provided that that is not a solution that is otherwise improbable. Hering goes through a complete discussion of the question in the case of the reduction of the plane of color-mixtures to a straight line,—that is, in the case of the partially color-blind. The discussion involves modern mathematical methods, which, as Hering has shown in the case of the horopter, are eminently applicable here also.

II. Hering lays great stress upon the fact that the nervous visual organ is an organic whole, and that when a stimulus falls upon a part of the retina, all the other parts, and especially those which are near, respond as well. This is the key-note of Hering's explanation of the phenomena of induced self-color. These phenomena are, according to Hering, of the utmost importance from a theoretical point of view ; the value of v. Kries' contributions to the subject may be inferred from the fact that he says (*Analyse d. Gesichtsempfindungen*, p. 133), that they have not nor *can* not contribute anything towards a theory of vision.

Hering repeats with various modifications, his fundamental experiments for exhibiting the *Licht-hof*, or bright border by which the dark after-image of a bit of white paper on black is surrounded. On Helmholtz' theory, this brightness is merely the ordinary self-light of the retina, heightened by judgment contrast with the dark after-image. Hering gives many ingenious experiments to prove that this is not the case, and in particular he provides that the " border " should be produced in one eye only while the other eye, having been shut (and hence rested), looks upon an actual grey surface with which to compare it. Anyone who has performed this experiment can no longer doubt that the " border " corresponds to a real sensation, of quite comparable intensity with that of a good grey light falling upon an untired retina ; there is no reason to suppose that it is not due to a physiological process, of whatever nature it may be, superinduced by the adjoining stimulation. In the same way the after-image of a black strip on a red ground may look a brighter red than an actual red with which an unfatigued eye compares it. Von Kries says that this can be explained as a propagation of the *stimulation* instead of the excitability. Hering in reply points out that (in the form of experiment in which a narrow black strip with a sheet of white on either side of it looks afterwards bright) the strip grows dark as the sheets are brought up and bright again as they are again removed, but that if the sheets diffuse a stimulation they ought to do it the more the nearer they are to the black strip. This reply is perfectly adequate, but to the reviewer it is impossible to see why it does not hold against Hering's theory as well.

What difference is there between an increased excitability and an increased excitation, of such a nature that one can be diffused when the sheet is not there and the other only when the sheet is there?

Von Kries says that this border is only seen on a dark back-ground, but that if it were caused by an increased excitability that ought to betray itself on a bright back-ground as well, whereas a real process might easily be so slight as not to be noticed in the presence of a greater one. Hering shows that, with a proper arrangement, it can be seen on a bright back-ground; but he does not explain why it ought not always to be easily noticeable on a bright back-ground. Hering points out that he has not proposed any theory as to what the physiological process is which is the basis of the increased excitability, but that he is only engaged at present in getting a correct mode of expression for the facts. A third position which v. Kries takes up is that everything can be explained as well by assuming that an excitation in one spot lowers, instead of heightens, the surrounding excitability, but Hering shows that this is quite incompatible with several variations of the experiment to which v. Kries has not applied it. [It must be remembered that *excitation*, according to Hering's complete theory, must correspond now to a state of super-nutrition and now to a state of mal-nutrition in the nervous structures; the co-color sensations, red-green and blue-yellow, are, according to him, processes of assimilation and dissimilation respectively. Hence Hering must say, in full, that a tearing down of nervous structures in one spot causes a *tendency* to tearing down in surrounding spots. But what can a tendency to tearing down consist in, if it does not consist in a greater built-up-ness of some chemical structure? A chemical substance which is the same as to quality and amount cannot be now more and now less loosely put together. Hering's theory would therefore seem to be *at bottom* the same thing as this suggestion which is casually thrown out by v. Kries. In fact, the reasonableness of Hering's theory of vision, as far as it involves assimilation and dissimilation is a very different matter from its reasonableness exclusive of those ideas. The whole subject is in a condition in which it will repay any amount of hard thinking and careful experimenting.]

III. The third division of Hering's paper deals with after-images. Von Kries overlooks the fact that according to Hering's theory, fatigue for one color can exist without producing any change in the sensibility to white; while according to Helmholtz, fatigue for one color involves a total change in the reactions to white light. Take a yellow which is produced, on Helmholtz' theory, by equal excitations of the fibres sensible to green and to red. Let white light presently fall upon the same spot of the retina, and the green and red fibres being equally fatigued, it ought to stir up the violet fibres only; but in fact the complementary color to yellow is blue, or, at most, an indigo-blue. [Helmholtz, it would seem, would need to add to his theory the assumption that the green fibres are exceedingly vigorous, and not easily capable of fatigue; but, in fact, it is as easy to get the complementary color to green as to anything else.] Hering proceeds to describe a very striking experiment; a piece of spectral red is looked at first, fixedly in a bright light, and then the light is diminished, (or the observer takes the red paper into a shaded place.) Instantly, although his eyes are open and he is looking at red paper in a not faint light, it looks to him of a bright blue-green. A modification of this experiment is to place three bits of paper (red, green and violet) on black, to look at a point midway between them for a moment, and then to turn down the light. Each bit of paper appears in its complementary color, and as all the colors are present, a mistaken judgment cannot be called upon for an explanation of the phenomenon. Simple fatigue cannot explain

it, for if the fatigue of the red fibres is so great that a real red looks blue-green, why does it not betray itself before the shadowing? If the shadow be removed, the red looks as bright as before.

We are forced to assume that exposure to red light causes a strong disposition to the production of a blue-green sensation, not simply an indisposition to the production of a red sensation. At this point Hering commits a curious error in logic. He thinks that the objection set forth above to the possibility of two complementary colors both containing any considerable amount of green is *more* forcible on the supposition that an image and its after-image correspond to positive and negative forms of one process (viz. growth and decay) than that they correspond to different *degrees* of a positive or a negative process merely. He forgets that the difference between two quantities, both positive or both negative, may easily be as great as that between a positive quantity and a negative quantity. His reviewer, Schön, in *Hermann u. Schwalbe's Jahresberichte über die Fortschritte der Anat. u. Physiol.* gravely sets forth this position of Hering's without comment. The objection is a perfectly valid objection to a three-color theory as opposed to a four-color theory, but it has nothing whatever to say to a theory of assimilation plus dissimilation as opposed to a theory which attributes complementary sensations to the breaking down of two different kinds of chemical substance.

On the whole, this paper of Hering's which contains a large number of ingenious experiments, for the most part carefully weighed, does much to strengthen the belief that the black-white sensation is distinct from the color-sensation, and not composed of its combinations, but very little to strengthen the belief that the sensations of black and white (and of the opposite colors) are the psychological aspect of anabolic and metabolic processes respectively.

The principal weakness at present which exhibits itself on Hering's side of the question is that in his late papers he confines himself to answering objections, and does not sufficiently indicate, at each step, in what way his own theory applies to the case in question. He has promised a full discussion of the subject *de novo*, but that discussion seems to be long in coming.   C. L. F.

Ueber den Farbensinn bei indirectem Sehen. Dr. CARL HESS. v. Graefe's Archiv für Ophthalmologie, Bd. XXXV, H. 4, 1889.

This very important paper is a thorough re-examination of the color sensibility of the peripheral portions of the retina. The general results are as follows: (1). Three kinds of homogeneous light can be found, and only three, which change in saturation, but not in color tone, as they are moved toward the periphery of the retina, the eye of course being wholly free from the effects of other color sensations previous or simultaneous. These are a yellow (wave length, 576–574 $\mu\mu$), a green (wave length 497–494 $\mu\mu$), and a blue (wave length 472–470 $\mu\mu$.) The same is also true of a fixed compound color mixed from homogeneous red and homogeneous violet or blue, except where the absorption of the *macula lutea* interferes. (The effect of the *macula* must be regarded in almost all these experiments so far as they are made with mixed colors.) These four unchanged colors are the primary colors (*Urfarben*) of Hering, determined in a purely objective manner. (2) Mixed lights agreeing with these in color-tone, and only such, behave as these do. (3). These four colors, homogeneous or mixed, form two complementary pairs *i. e.*, the mixture of the red and the green and of the yellow and the blue gives white. (4) Reds and greens that differ from the primary red and green become more and more yellow or more and more blue as they advance toward the periphery, finally losing all red and green character and appearing a more or less sat-

urated yellow or blue.   The points at which this happens as also that at
which the primary colors fade out, depends on the saturation, the size
of the retinal area affected, the brightness of the color, the brightness
and color of the back-ground, and the radius of the retina along which
the colors are advanced.   (5)   The best method for fixing the point at
which the color fails to be seen is to make the back-ground exactly as
bright as the colored spot becomes when it has lost its color, in which
case it fades into the back-ground and becomes wholly indistinguishable.
(6)   The colorless brightness or "white valence" of two colors may
be assumed to be equal when on losing their color they become indis-
tinguishable from the same back-ground; and the "color valence" of
primary red and green may be considered equal when, being mixed in
equal quantity the y produce white.   Fields of primary red and primary
green examined u nder exactly parallel conditions, (*i. e.* when they have
equal "white valence" and equal "color valence;" when they are of
the same area, are observed with the same portion of the eye and against
the same back-ground,) become colorless at the same distance from the
center of the field.   The same is true for primary yellow and blue.   (7)
From this it follows that the red sensibility and green sensibility decline
exactly together as the periphery is approached; likewise the blue and
yellow sensibilities, but much less rapidly.   (8)   No fixed point can
be assigned where these colors will invariably disappear, though such
a point can be found for any given set of conditions.   (9)   White light
appears white at all points of the retina.   All colors matched on the
red-green sensitive part of the eye (except the *macula lutea*) match on
all other parts, but colors that match on red-green blind areas, while
they match for all other red-green blind areas, do not necessarily match
for those that are red-green sensitive.   It is hardly necessary to say
that most of these observations, which in part support and in part
supersede previous observations, are very much more easily explicable
on the color theory of Hering than on that of Young and Helmholtz.

The experiments of Hess were conducted with great care; when
spectral light was used the eye was kept in the dark for from 15
minutes to half an hour before observation; and care was taken to
avoid fatiguing the retinal spot worked upon.   The device (one of
Hering's) for obtaining a definite area of a definite color in a field of
exactly the right shade is especially simple and effective.   Through a
small round hole in a horizontal screen of gray paper the observer looks
down upon the horizontal disc of a rotary color mixer.   If the hole is
clean cut, the portion of the disc seen below appears in indirect vision
simply like a colored spot on the surface of the screen.   By changing
the inclination of the screen with reference to the light its brightness
can be considerably varied, and with a set of interchangeable screens
any desired degree can easily be secured.   With the same apparatus the
"white valence" of colors at the point of disappearance can be meas-
ured by the width of the black and white sectors required to make a
gray with the disc of the color mixter that shall be indistinguishable
from the gray of the screen when the eyes are in the same position as
that at which the color disappeared.   E. C. S.

Ueber die Hypothesen zur Erklärung der peripheren Farbenblindheit.   Prof.
   EWALD HERING.   v. Graefe's Archiv für Ophthalmologie, Bd.
   XXXV, H. 4, 1889.

In this article, which in a sense furnishes a theoretical and polemical
part to the article of Hess above, Hering subjects the explanations of
peripheral color blindness advanced at various times by Helmholtz and
Fick to a vigorous examination.   The first view, conjecturally advanced
by Helmholtz, was that the sensibility for red in the peripheral zone
was less than for green and blue, approximating a red blindness.   This

however was contradicted by observations, among others, mentioned by Helmholtz himself, namely, that red and green appear yellow when moved toward the periphery (according to the Young-Helmholtz theory a union of red and green sensations are necessary for yellow), and that blue became a grayish white, for which on that theory all the sensations must be present. The colors that are still seen should also look more saturated as the others fail, but directly the reverse is the case. To avoid this difficulty the hypothesis of Leber and Fick was proposed. Fick assumed, instead of an absence or loss of function in any of the three kinds of nerve fibers, that all three were functional, but that the degree in which each kind was excitable by the various homogeneous lights of the spectrum changed continuously from the center toward the periphery, so that in the so-called red-blind zone the red and green fibers had a like degree of excitability toward all lights, and in the extreme peripheral zone all three kinds had the same degree. Such a hypothesis adapted to fit a photochemical explanation of vision is given by Helmholtz in the new edition of of his Physiological Optics.

Against this hypothesis, which Hering regards as itself destructive of the Young-Helmholtz theory, he urges the theoretical objections that it is illegitimate to assume three color sensations where two or only one would be sufficient to satisfy the law of color-mixing, and at the *same time* to deduce from that law the dictum for the center of the retina that there can only be three primary sensations, which certain of the representatives of the theory, (though not Leber and Fick) have done. Furthermore since the color-sense changes on the retina continuously, an infinite number of different ratios of excitability must be supposed. Theoretical objections aside, however, the theory breaks down in explaining facts such as those brought out by Hess, whose results Hering here resumés. Moreover, in order to explain a part of these results on the Young-Helmholtz theory the assumption is forced that *all* colors remain unchanged in color tone as they move toward the periphery, which is flatly contradicted by others of them. Whence it follows " that the Young-Helmholtz theory in general offers no possibility of explaining the above cited and for the most part already long known facts, and that it is by them alone to all intents refuted." Another explanation of Helmholtz, advanced at the same time with the last, was this, namely that when one of the primary sensations is wanting, we learn by experience which sensation of those remaining corresponds to the most frequent and intense sensation received from luminous bodies, i. e., white. From this as a basis we " interpret the rest of the perceptible colors as colors of a line which is laid in the color triangle through the place of white, parallel to the line joining the two fundamental colors yet retained. This would go, if red were lacking, from yellow through white to blue " (Phys. Opt. 2nd. ed. p. 374). Though yellow and blue are the colors seen on the " dichromatic " parts of the eye, this statement as it stands contains a palpable error; for it is when green and not red is lacking that the line would go "from yellow through white to blue." Helmholtz explains that we do not recognize the colors seen at the periphery in accordance with the actual sensations received there for the same reason that men for thousands of years failed to discover that all colors were not seen with the periphery. To this Hering replies that men, to be sure, did not recognize the peculiarities of the color vision of the periphery because they never had need to attend to them. When attention is once given, the color is recognized as it is seen; a violet color is seen blue, and not the clearest knowledge that it is violet can help it in the least. The facts that Hering finds thus in such disaccord with the theories of Helmholtz and Fick, are so easily explicable, he thinks, on his own theory that he waives detailed explication.   E. C. S.

Ueber Beziehungen zwischen Farben und Tönen. Prof. PIETRO ALBER-
TONI. Originalmittheilung, Centralbl. f. Physiol. No. 15, 26 Oct.
1889.

Drawing parallels between color and tone has been a tempting occu-
pation to many people. Hauth for example assumes three primary
colors, blue, yellow and red, and over against them three primary
tones *c* (*do*), *e* (*mi*), *g* (*sol*). Prof. Albertoni has, he believes, found
clinical evidence for something of the kind in the case of three color-
blind persons. Two were red-blind and failed to distinguish *g* (*sol*) ; and
one was green-blind and failed to distinguish *d* (*re*). The persons tested
were of musical ear, and their failure to perceive these tones consisted
in inability to distinguish them from neighboring tones on the piano and
to sing them accurately when they were given. Some persons not red-
blind were also found who could not produce *g* (*sol*), but whether from
failure of perception or of voice mechanism does not certainly appear.
For the first cases Albertoni proposes the name "auditory daltonism."
[The natural comment on these observations is : Interesting, but in need
of confirmation. It is not impossible that tone-deafness may be found
more frequently in the color-blind; but what is to be said of its corres-
pondence with the three-color Young-Helmholtz theory which seems
now on the point of collapse? REV.]   E. C. S.

Studien über die elementaren Farbenempfindungen. Erster Abschnitt. FRI-
THIOF HOLMGREN. Skandinavisches Archiv für Physiologie, Bd.
I, H. 1-3, 1889.

Finding himself definitely prevented from completing his studies, in
large measure because of the eye-strain entailed by them, Prof. Holm-
gren is compelled to give his researches to the public, if at all, in their
present incomplete condition. He is further urged to publication by the
criticisms, both theoretical and experimental, which the preliminary
accounts of his work have drawn from Hering (*Pflüger's Archiv*, Bd. xl,
1,) and Isaachsen (*Ibid.*, Bd. xliii, 289). His line of experiment was
this, namely, to bring upon the retina a point of light fine enough to
stimulate the visual elements singly, and thus call out the three funda-
mental sensations which should result according to the Young-Helm-
holtz theory. This first paper is devoted to the statement of the
problem, to the preliminary experiments, and the choice and management
of the apparatus. The experiment, if it can be generally verified, is
one of such great importance for the theory of color vision, that the
continuation of Holmgren's account of it will be looked for with
interest. Incidentally, the author observed a very interesting instance
of the effect of muscular sensations upon vision. In looking at his very
faint and fine points of light with eyes somewhat elevated (the same
thing, he says, may be seen on looking with the eyes in that position at
a gas flame turned down to the faintest blue), the image seems to move
constantly upward or in the direction of the muscular exertion—that
is, the sensation of continued tension expresses itself in the illusion of
continued motion.   E. C. S.

*Ueber Nachbilder im Binocularen Sehen und die binocularen Farben-
erscheinungen überhaupt.* H. EBBINGHAUS. Pflüger's Archiv
XLVI, pp. 498-508.

Ebbinghaus describes a simple phenomenon in the subject of after-
images that seems to have been hitherto overlooked. The left eye, say,
looks at a bit of bright paper an a dark ground, while the other eye,
being open, is prevented from seeing it by a piece of card-board. On
suddenly shutting the left eye, a *positive* after-image is seen by the
right eye on the piece of card-board. It is certain, Ebbinghaus thinks
that this after-image is due to the right eye, because the circumstances

are not such as to cause a *positive* after-image in the left eye, that being caused only by a relatively bright light or in a well-rested eye. In the given circumstances, it cannot be detected with the right eye closed. Moreover, this after-image can be got, though with more difficulty, even if the left eye is kept open, provided the bit of bright paper is cut off by a piece of card-board; but these are conditions under which, according to all that we know about after-images, only negative ones can arise in the affected eye. Ebbinghaus does not suppose that in this phenomenon an actual effect is produced in the right retina, but rather that it is due to central processes; and in supposing this he does not consider that the well-founded belief that ordinary after-images are peripheral is at all affected.

The hypothesis that an excitation of one eye produces an effect in (at least the central attachments of) the other eye, Ebbinghaus considers is borne out by other facts. In binocular color-mixing, *two* colors are produced which succeed each other by rivalry; even when the colors mixed are nearly alike and the composed color looks like one, it will be found, on trying to match it with pigments, that it is really two. Ebbinghaus' hypothesis here is that the two eyes see two distinct images, A and B, and at the same time two faint, sympathetic images, *b* and *a*; and that rivalry takes place between the fused pairs, A, *b* and B, *a*, the color of the mixture thus leaning now towards one and now towards the other of the component colors. [This is the same thing as saying that a real *binocular fusion*, in the original meaning of the phrase, does not take place at all.] A similar explanation is applied by Ebbinghaus to binocular contrast.

The new phenomenon described is difficult to get and Ebbinghaus recommends trying it, for the first time, after a sleepless night.

C. L. F.

Optische Urtheilstäuschungen. Dr. F. C. MÜLLER–LYER. DuBois–Reymond's Archiv. Supplement Band, 1889.

The interesting illusions described and explained in this article are difficult to understand without the accompanying illustrations. If we draw an acute angle and an obtuse angle with equal sides, the sides of the latter will seem very much longer than the sides of the former, and this effect will be the more marked the greater the difference in the two angles. Again, draw a pair of such angles and connect their apices by a straight line, and the straight line connecting the obtuse angles will seem longer than the one connecting the acute angles, that is, provided the sides of the angles are directed towards the connecting line; if they are directed away from this line, then the line connecting the acute angles seems the longer, and the contrast becomes strongest in comparing two lines connecting pairs of acute angles, alike in the size of the angle and the length of the sides, but the one directed towards, and the other away from the connecting line. The same illusion appears in various forms: the sides of a triangle seem smaller than the sides of a square, though really the same; and the sides of the square will seem shorter than the equally long sides of a pentagon or hexagon, and so on. The general principle of explanation is, that the more contracted the suggested environment of the space-dimension in question, the smaller will it seem. This explains at once why the sides of acute angles seem shorter than those of obtuse ones, why lines with contracting angles or curves seem shorter than lines with expanding outlines at their extremities; why a space between two narrow oblongs seems larger than the same space between two squares, or a distance on a line marked off between two short lines seems longer than the same distance marked off between two longer lines, and so on. It is also to be noted that these illusions differ from the ordinary effects of contrast in that

while in contrast the stronger effect weakens the effect it accompanies, here the reverse holds true. With these are connected two other types of illusions, the one referring to the change of form of the contour of an interrupted figure, as when a portion of the circumference of a circle is omitted; the other to the contrast induced by placing the smaller side of one of two equal figures next to the larger side of the other figure, and thus causing the first to seem smaller, etc. These illusions are all clearly marked, have a wide field of application, and promise to repay further study.   J. J.

Das Netzhautbild des Insectenauges. Prof. SIGMUND EXNER. Reperto-
    rium der Physik, Bd. XXV, H. 9 und 10, 1889; also Sitz.-Ber. der
    Wiener Akad. (3 Abth.) Bd. 98 (1889).

In this paper, which in some sense corrects and completes an earlier one on a similar subject, Prof. Exner seems to have definitely settled the question as to whether insects with compound eyes see by means of a single erect image, (Johannes Müller's view), or by means of a multitude of little inverted images, (as held by several later observers), and to have settled it in favor of the earlier view, at least with modifications. By taking the eye of the male firefly (*Lampyris splendidula*), (the same might be done with the American *Elater noctilucus*), replacing the softer parts with diluted glycerine, and mounting it under the microscope (power of 60-100) in such a manner that the convex surface was free to the air as in life and the focal plane of the microscope lay in the place once occupied by the retina, he was able to observe the image directly, and by focussing up and down to study its nature and formation. The dioptric unit of the compound eye in this insect consists of a crystal cone (*Krystallkegel*), the lower end of which is rounded into a lens-like point, and of the attached corneal facet, also lens-shaped. This crystal cone, assisted somewhat by the lens-forms at its ends, but depending in large measure on its own peculiar refractive powers, behaves like a minute astronomical telescope and projects an erect image of the portion of space to which it is directed on the retinal elements lying below it. The neighboring cones also project similar images, each differing slightly because of the different directions of the cones. The points of these images that represent the same objective points in space coincide, and thus form a "summation image," which was that observed by Exner. In the eye of *Lampyris* as many as thirty cones contribute to the "summation image" of a small light object. The peculiar refractive powers of the cones rests in the increase of the refractive index in successive strata from the convex surface toward the axis. To account for the presence of large quantities of pigment in the space between the crystal cones and the retina in some insects and its absence in others (*e. g.* these fireflys) the author offers this hypothesis, which in a later paper (*Sitz.-Ber. der Wiener Akad.* Bd. 98, (3 Abth.,) v. 21 März, 1889.) he has substantiated by observation, namely that when the eye is exposed to light the pigment spreads backward from the region of the cones into the otherwise free space. The effect of this would be to cut off as it advanced more and more of the single images going to form the "summation image," proportionately reducing its intensity; it would thus serve the same function as the iris in the eye of higher forms. The author by no means believes that the eye of *Lampyris* is typical of all composite eyes, though the understanding of it is an advance; indeed he devotes a section to the consideration of other forms in which the structure is different. For these details, however, and for very much information not easily abstracted, or not of immediate interest here, *e. g.*, the other optical images to be observed in addition to that mentioned above, the physico-mathematical consideration of the crystal cones, the measurement of the eye, the

developmental relations of the simple vertebrate eye and the compound eye, etc., etc., the reader is referred to the full treatment and the cuts of the original. E. C. S.

Psychophysische Untersuchungen. Dr. F. C. MÜLLER-LYER. DuBois-Reymond's Archiv. Supplement Band. 1889. pp. 91–141.

This very extensive research is so intimately connected with the many explanatory tables and illustrations, that a resumé of its contents must be confined to a statement of the most general points; special students of psychophysics must go to the article itself for the detailed numerical results and their justification. The article begins by maintaining that it is wrong to speak of *the* psychophysic law, for there may be any number of such laws; the problem is to determine all the conditions that affect sensibility to differences of stimuli, and the intensity is but one of such conditions. There will be here considered the relation of the intensity and the extension of optical stimuli to the sensibility. The author had shown that Weber's law does not hold for sensations of brightness (method of detecting the difference between two differently illuminated discs), but as the stimuli increase, the sensibility increases, though at a constantly decreasing rate. This was tested separately for each eye, with a light disc upon a darker ground or vice versa, for a great range of intensities, etc. This may also be expressed by regarding the effect of the application of the stimulus to be the lowering of the irritability, but not as rapidly as the stimulus increases. It is concluded that for visual sensations, as the stimulus doubles its value, the irritability decreases by one-third its value. Some of these points were specially tested for peripheral regions of the eye, and it was found that such portions are in general more sensitive to the vision of small dots than the fovea, and also that Weber's law seems to hold better for the peripheral than for the foveal portions. Had the sensibility been independent of the intensity of the stimulus, the determination of the relation of sensibility to the extension of the stimulus would be easy; but as it is, we are dealing with two variables at a time, and have the complex problem of determining how the sensibility changes for each intensity when the extension remains constant, and how it changes for each extension when the intensity remains constant. This the author does for visual sensations, expressing the result by a surface in the three dimensions of space. For changes in extension, the general result is that as the surface upon which the judgment of difference of illumination is founded is increased, the sensibility increases, at first relatively rapidly, and then more and more slowly. These relations are subjected to a minute experimentation, the result of which is a series of tables expressing the influence of the changes in any one of the factors of the stimulus upon the rest. The main point is the treatment of the sensibility, not as dependent upon a single variable, but upon several. The article certainly merits detailed study, but the question arises whether these exact and many-sided calculations are warranted by the accuracy of the method, and whether we should not demand a corroboration of these results by other methods before drawing the sweeping generalizations here propounded. J. J.

Neue Grundlegung der Psychophysik. HUGO MÜNSTERBERG. Beiträge zur experimentellen Psychologie. Heft, 3. Freiburg, 1890. pp. 122.

It is impossible to notice this original and painstaking contribution to Psycophysics without renewing the protest against the undue length to which all the studies of this series have been drawn. It is not sufficient that the spirit of science should enter into the methods of the new Psychology; it must also enter into its exposition, and we feel assured that the author is very considerably diminishing the influence of his

work by his undue prolixity. The three instalments of Dr. Münster-
berg's work could easily have been printed in a pamphlet the size of the
smallest of them, without omitting anything essential or important. If
this disastrous policy is to be continued, let us at least be supplied with
an index of principal points, so that those who want merely the kernel
of the work may know where to find it.

The cardinal thought of this research is, that we cannot measure
sensation-intensities in the ordinary sense, because only that which can
be reduced to units can be measured. A weaker sensation is not con-
tained in a stronger as an inch is contained in a foot or an ounce in a
pound; but each intensity of the stimulus gives rise to a sensation
qualitatively different from any other sensation. All quantitative dif-
ferences of sensation are thus resolved into qualitative differences—of a
special kind, however, namely, such as depend upon differences of
muscular tension. It is held that our organism reacts to every stimulus
by reflex muscular innervations which give rise to feelings of tension
(*Spannungsempfindungen*), and it is the perception of differences of
degree of these feelings that lies at the basis of intensity distinctions.
All physical measurements ultimately depend upon space, time and
mass, and each of these is connected with muscular sensations; so
that it is the production of like muscular sensations that in the last
analysis makes measurements possible. This is equally true of
measurements of sensation, and it is owing to the fact that in these
muscular feelings the more intense really includes the less intense, that
the measurement of sensations of intensity is possible. (A long digression
discusses whether sensations of sound-intervals can also be reduced to this
category.) If this theory is true, then, Dr. Münsterberg infers, sensa-
tion-differences will be perceived as equal when they give rise to the
same difference of sensations of muscular tension, and inasmuch as
these occur in all senses we should be able to compare sensation-dif-
ferences amongst disparate senses. This apparently difficult, if not
impossible problem, we are assured, is easy when we once set about
it, and we are presented with the result of such a series of trials. One
black disc was kept constant with 20° of white, while another was
changed by 10° changes from 20° to 180°; again the left arm made a
constant excursion of 20 cm., while the right arm made an excursion
that would seem as different from the excursion of the left arm as the
second disc seemed lighter than the first. In the same way, differences
of pressure and differences of sound-intensity were compared, or rather
translated into differences of arm-motion, and though the separate
experiments were conducted in an utterly irregular order, the result is
a very orderly rise of the excursion of the right arm with the differences
in the lightness of the two discs, or the weight of the two weights, or
the loudness of the two sounds. The same three classes of sensations
were also translated into differences of visual extension, and with an
equally satisfactory and regular result. The results are not considered
sufficiently numerous or accurate to warrant attaching importance to
the numerical tables (especially as they are founded upon but one sub-
ject, Dr. Münsterberg); but they are tested in several ways, and found
to give consistent results among themselves. The relative increment of
stimulus for the different senses, however, does not seem the same, but
the percentage of stimulus-increment necessary to produce equal dif-
ferences of sensation in the three senses of pressure, hearing and sight,
are in the ratio of 2.0, 1.0 and 1.24. This practical result is held to give
the theory an unusually high degree of probability, and it is furthermore
shown that the theory is capable of harmonizing the contradictory
results of different observers in a variety of ways. For example,
whether the method of mean gradations will give an arithmetical or a
geometrical mean, will depend upon whether we attempt to

place a sensation in between two others which will seem in absolute value equally distant from each of the other two, or whether we attempt to make the differences of sensation, *i. e.*, the differences of the muscular tensions, alike. In the latter case Weber's law will hold. The law, too, will hold, for the same reason, when the direction of the difference of sensation is perceived, but is not so likely to hold when the bare difference, without a perception of the direction of this difference, is tested.

Interesting and original as this theory is, it cannot be accepted without much experimentation by rigid methods and with due reference to other modes of explanation of the results. It is certainly difficult to conceive that the difference between two pressures or two sounds can be equal in any sense to the differences between the lengths of two lines. What seems to have taken place is this: the weakest and the strongest sensation in each sense were known, as also the number of different sensations in between; the smallest sensation was naturally associated with the shortest length, and the movements of the eyes or the arms having their natural limits, these limits stood for the most intense sensations. The results would then simply show that it is possible to keep in mind these ten sensations or differences of sensation in the disparate spheres of sensation, and make the several intervals or magnitudes correspond roughly each to each. That this power is interesting and worthy of study cannot be doubted, but that it can only be explained by the theory of muscular-tension feelings, or proves this theory, is by no means clear. J. J.

Sur la perception des radiations lumineuses par la peau chez les Protées aveugles des grottes de la Carniole, RAPHAEL DUBOIS. Comptes rendus. T. CX, p. 358, 17 Fév., 1890.

The ocular vision of these creatures is so imperfect that they will run against objects set in their way. They nevertheless perceive the difference between light and darkness, (in part by means of a kind of dermal vision most distinctly marked at certain points about the head and tail), and are profoundly disturbed by the former. In the dark they will remain for a long time in one place, but on being stimulated with a beam of light soon make efforts to escape. This characteristic has been used by Dubois to determine what might be called their reaction-times. In 43 experiments the average time was 11 seconds; in 30, in which the eyes were covered with an opaque mixture, there was reaction in about 24 seconds, except in three cases where there was none at all. With colored lights (produced with colored glass) for which the intensity of the illumination decreased in the order, yellow, blue, red, green, violet, and with the eyes open the following times were found: violet 26 seconds, blue 23, red 16, green 13, yellow 10.5. Where the eyes were covered the results with colored lights were conflicting, probably from too frequent repetitions of the tests. The order of preference of the animals was: black, red, yellow, green, violet, blue, white. The same author has studied the visual ability of the molusk *Pholas dactylus,* see *Comptes rendus.* CIX, pp. 233 and 320.

Experimentelle Studien über den Zeitsinn. MICHAEL EJNER. Inaug. Diss. Dorpat. 1889.

The intervals studied by Ejner were very much larger than those used by most previous experimenters, 0.5, 1, 2, 3, and 4 minutes. The method was that of average error and both forms of it were used: single reproductions, for which the standard is given each time, and multiple or serial reproductions where the standard is only given at the beginning of the series. The time was measured with a stop-watch of some kind,

capable of indicating fifths of a second. During the experiments the
subject endeavored to keep himself as much as possible in repose.
Ejner himself served as a subject for a large part of the experiments,
but a certain number were made on others, including three morbid cases:
a neurasthenic, and one each in a maniacal and in depressed condition.
His results may be summarized as follows: By the method of sin-
gle reproductions the estimated time was always too short (least so
for the interval of two minutes, both relatively and absolutely); by
that of serial reproductions it was too long (most so for the interval of
two minutes, absolutely but not relatively), except for the longest
interval. The average error by the first method is smaller than by the
second in about the proportion of 2 to 3. The average error bears an
approximately constant relation to the reproduced interval (not the
standard); to this extent the requirements of Weber's Law are fulfilled.
The average error is reduced by practice; the estimated time is made
shorter by fatigue and longer by practice. The estimation of time de-
pends chiefly on the feelings of inner effort such as accompany the strain-
ing of attention on the interval and the like, a result not so far from that
of Münsterberg (cf. this JOURNAL, Vol. III, p. 130). In the psychopathic
cases the time estimates were less accurate. In a few experiments, made
by the method of serial reproduction on a normal subject with intervals
of 0.5 and 4 minutes, a metronome was allowed to tick at the rate of 200
per minute, or the subject performed a somewhat elaborate process in
mental arithmetic. These showed a greater regularity of estimate than
before, and the estimated time was shorter, especially for the shorter
interval. The author fails to make mention of the work of Stevens
(*Mind*, Oct., 1886), who likewise approached the problem by the method
of multiple reproduction, though using shorter intervals.

III.—MORBID PSYCHOLOGY.

RECENT DISCUSSIONS ON PSYCHIATRIC CLASSIFICATION AND NOMENCLATURE.

BY WILLIAM NOYES, M. D.

Katatonia. MM. T. SÉGLAS and PH. CHASLIN. Brain, July, 1889.
(From Archives de Neurologie.)

Séglas and Chaslin have contributed a valuable critical paper on the
history of Katatonia, and have summed up our knowledge of this vexed
subject fairly and justly. Kahlbaum's monograph, *Die Katatonie*
appeared in 1874, and since then there has been much division of
opinion, as to whether he had really described a new disease or
only a group of symptoms. Kahlbaum tried to define a form of
disease in which certain physical, and particularly muscular symp-
toms accompany (as in general paresis, and as frequently) certain
psychical phenomena, and play a leading part in the whole morbid
closely process. This new form of mental derangement may be
allied to melancholia attonita, which is ordinarily considered a
distinct disease. On careful examination of the latter disease, we can
very often, according to Kahlbaum, discover at the onset, epileptiform
seizures or other manifestations of spasmodic attacks. These conditions
become permanent, attain their greatest development in the *flexibilitas
cerea* stage of the mental condition, and merge into the final stage of de-
mentia. These symptoms are by their importance placed in a line with
the paralytic phenomena of general paralysis. By their side, and in ad-
dition to the usual symptoms of melancholia attonita, we find other
physical, and more especially psychical phenomena, notably a particu-

lar form of exaltation, which may be termed "*pathetic estasy*," as well as
a tendency to speak as if discoursing or to recite, which gives a charac-
teristic physiognomy to the disease. All these symptoms constitute
what is called Katatonia, and up to a certain point this form of disease
should be considered as a counterpart to certain forms of general paraly-
sis with or without grandiose delusions. Analogous to general paralysis
as regards the succession of different psychical phenomena in connection
with the muscular symptoms, they seem to differ from it, on the con-
trary, by the quality of the muscular and psychical manifestations, and
consequently a marked difference is to be found in the prognosis. Those
who have recorded themselves in favor of the entity of the disease are
Hecker, Kiernan, Hammond, Spitzka, Neuendorf, Neisser, and Schüle;
while Arndt, Westphal, Tigges, Von Rinecker, and Krafft-Ebing entirely
oppose the conception. The first group claim that it is an essential
morbid form; the second that the cases classed under that name are only
variations of types already known and described. Amongst the charac-
ters given as pathognomonic, of chief importance, are placed katatonic
phenomena of the most varied nature: the pathetic attitude, stereotyped
gestures, verbigeration, marked obstinacy (often systematic), and finally
the cyclic course of the disease. Are these katatonic phenomena, as
well as others mentioned before, really characteristic of a special form
of mental disease? After considering this question with care, and study-
ing the phenomena in degenerative conditions, our authors conclude that
katatonic phenomena, taken singly, have nothing to characterize them,
for they are found in a multitude of .mental affections. Apart from
accidental motor disorders, such as spasms or contractions, which one
may meet outside mental diseases properly speaking, there are motor
disorders which belong specially to insanity, and which can be present
in the most varied forms of mental disease, divided by Morselli into states
of increased reflex excitability of the muscles (tetany), increased mus-
cular tonicity, (catalepsy,) and states of abnormal distribution of central
motor impulses, (such as stiffness at the beginning of a movement).
Consequently we may say with Arndt that the insanity of tonicity
(*Spannungs-Irresein*) is not a disease, but may develop itself upon the
most diverse grounds, and under the most varied conditions; and further
considering them only in the cases called Katatonia, their mode of de-
velopment, course and relations with the other symptoms, have nothing
to specify them, and they present no regular characteristics. Other
katatonic symptoms, verbigeration, dumbness, stereotyped gestures,
pathetic attitudes and systematized resistance, are equally proved not to
be specially characteristic of Katatonia; and neither does the course of
the disease, called cyclic, offer anything characteristic, for the variable
conditions through which the disease passes have nothing regular in
their mode of appearing or in their relative positions. The stages in the
cycle of Katatonia show nothing but what is known to occur in many
other diseases. Kahlbaum himself recognizes "that mental diseases in
general, including Katatonia, begin with melancholia, pass into mania,
next into *Verwirrtheit*, and finally end in dementia," and in another place
he says, "Melancholia attonita, which has been considered until now as
a special form of disease, *develops itself primarily in very rare cases;* it
pursues in general rather a course of simple melancholia, or a condition
of melancholia following mania in such a manner that the melancholia
attonita is the third stage of the complete process which terminates in
recovery or dementia."

To sum up: Isolated, not one of the symtoms reviewed can by itself
characterize a special psychopathic form of disease. Is it otherwise
with them when considered *in toto ?* In short, in order that a union of
symptoms not characteristic in themselves may constitute an essential
pathological entity, it is necessary that they possess among themselves

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close relations with regard to their nature, origin, mode of succession
and causation, in such a manner that notwithstanding their inevitable
variations, one can always grasp their relations, recognize their connec-
tions, and refer them to a defined primitive type, and to a common
superior cause. We do see a co-existence in the description of Kata-
tonia, but not an association or a combination of symptoms.

The etiological causes which Kahlbaum gives are perfectly common-
place ones, and such as we may find at the source of all possible forms of
mental disease. There are, however, two causes, not mentioned by
Kahlbaum, which in the opinion of Séglas and Chaslin might induce a
special predisposition and serve to characterize the foundation on which
the disease develops itself; these are degeneration in general and the
hysterical state. Séglas and Chaslin, from a study of the cases, feel
justified in asserting that these factors have been overlooked by the
advocates of Katatonia. Finally, they complete their study by saying
that Kahlbaum's attempt does not seem to them so far sufficiently justi-
fied; and they repeat with regard to Katatonia what has been said of
catalepsy, namely, that in the description of this affection, some authors
have coupled together facts which, from different points of view, are
dissimilar; and that they have rather recorded the history of a symptom,
(or better, of a "syndrome,") than of a veritable disease.

If we consider further that from the physical point of view the promi-
nent symptom is the presence of disturbance of the neuro-motor functions,
while the principal psychical feature is a more or less acute condition of
melancholia, (the other symptoms, progress, etc., presenting nothing
special,) the opinion must be formed that for the present Katatonia must
be classed under the general group of stupors—simple or symptomatic—
of which it may only be a variety more closely connected with a degen-
erative and more particularly hysteric ground. This conclusion, the
authors add, is not an explanation, but it is to their mind the only opin-
ion which can be formulated in the present state of science.

Ueber Heboïdophrenie. Dr. Kahlbaum. Allgem. Zeitsch. f. Psychiat.
    Bd. XLVI, H. 4, 1889.

Kahlbaum's conception of *Hebephrenia* has been before the psychiatric
world since 1870, (Virchow's Archiv, Bd. 52) and after 20 years he now
puts forward a claim for a separate position in classification of a second
form of the insanity of pubescence, under the name of Heboïdophrenia.
Before discussing this second form, it may not be improper to review the
position assigned to Hebephrenia by Kahlbaum's fellow alienists.

Krafft-Ebing, (Lehrbuch, 3d Edition, 1888, p. 162) in discussing the
Causes of Insanity, gives the influence of the time of life, and concludes
his review of the influence of puberty by citing the group of symptoms
called hebephrenia by Kahlbaum, and sums up as follows: "The right
to put forward hebephrenia as a separate form of disease, seems to me to
be questionable," and he quotes Schüle as finding only two cases of pure
hebephrenia among 600 patients, while he himself in 3000 found only 8,
and in all of these there was hereditary predisposition, original imbecility,
and signs of degeneration; two were microcephalic. The only case he
cites has the heading "Maniacal insanity in puberty with hebephrenic
symptoms."

Schüle (Handbuch, 1886, p. 508) places hebephrenia under Idiocy, of
which he makes six types, the last being the type Hebephrenic Imbecil-
ity—"the true hebephrenia, the pubetic insanity, as it has been designated
by Kahlbaum and Hecker, may find its place here, although it does not
always develop on a basis of idiocy, yet in the great majority of cases
leads to a persistent imbecility."

Kraepelin, (Psychiatrie, 1889, p. 52,) under general etiology, simply
states that one of the frequent clinical pictures of psychical disturbances

occurring in youth is described as hebephrenia, "characterized by the change in the superficial emotional conditions; odd, fantastic delusions, eccentric behavior; and the quick passage to dementia."

Arndt, (Lehrbuch der Psychiatrie, 1883, p. 273), referring to Kahlbaum's classification, in which hebephrenia is included, says that while these distinctions may appear to have their foundations, yet they also have their difficulties and have practically no significance.

While all admit, therefore, that Kahlbaum has described a real condition, they would refuse it the dignity of a special place in the classification of mental diseases, claiming that it may more properly find its place in some of the present existing groups. Despite this attitude, however, Kahlbaum proposes to divide the insanity of pubescence still farther, and to make two distinct diseases where he has heretofore claimed only one. Owing to its close relationship to Hebephrenia, he proposes to call the new disease Heboïdophrenia, (on the analogy of *typhus—typhoid*).

Under Heboïdophrenia, or simply heboid, Kahlbaum understands a psychical disease making its appearance in youth, and of such symptomatic peculiarities that it is covered by none of the forms of mental disease described up to this time.

The following are its peculiarities:—

1. In anomalies of the general behavior; in deviations and anomalies of that complex of mental qualities which make up the psychical individualities of man in his social relations, and which taken together are called his character, personality or temperament.

2. These characteristic peculiarities consist in deviations and anomalies of the instinctive life, and are comprehended in a deficiency or variation from custom and morality, and in extreme cases manifest themselves as criminal tendencies or as criminal acts. Other symptoms, such as a weakening of the intelligence, or on the other hand a high development of this, an extremely genial nature, a diminution or increase of the emotional life, may likewise be present in individual cases, but are not characteristic and may be entirely wanting.

The above symptomatic peculiarities Kahlbaum has already pointed out in the disease entitled by him Hebephrenia, and he has been led to the study of the new disease through a study of Hebephrenia. He would distinguish, therefore, two forms of the insanity of pubescence. In one the attacks are much stormier and lead through different stages eventually, and indeed generally in a short time, after a relatively short course to a decline of mental power; this is hebephrenia proper. The other group has a course that is much less stormy; the patients may indeed show a change of disposition, but they remain in essentially the same condition of mental capacity that is characteristic of their individual endowment, and in general do not pass into confusion or imbecility. To the superficial or casual observer they show much less the stamp of mental disease than of poor education. Differences are also to be noted in other directions. The first cases of hebephrenia are symptomatically comprehensive and severe, the last are narrowly circumscribed, and while the first are to be noted as generally incurable the last may generally be looked on as curable. Since, however, both forms belong closely together, the last form is to a certain extent only a sub-division of the clinical picture of the first. Kahlbaum gives the clinical history of two cases, one at considerable length, but a careful examination fails to show why they might not equally well be included under hebephrenia. Kahlbaum holds it as an important point to note that these patients do not fall into mental decay, and if this had been the case they would have belonged to hebephrenia. But it appears to be an over-refinement to attempt to form a new disease out of cases which present a clinical picture similar to a form already described, but not sinking quite so low in disease, and rallying after a comparatively short time. Spitzka, who admits hebephrenia into his classification, and calls the prognosis on the whole

exceedingly unfavorable, takes a more rational view, when he says, (*Insanity*, 1887, p. 177) : " Imperfectly developed cases, such in which the disturbance is limited to a slightly strained emotional condition, with a tendency to writing silly and extravagant poetry, and which appear to be merely instances of a pathological intensification or undue prolongation of the ordinary pubescent state, present better prospects." While welcoming therefore every minute clinical study of mental disease, which cannot but help to increase knowledge, those who are struggling with the already over-burdened sub-divisions of classification must regret, as tending to still greater confusion, all attempts at further sub-division, if the cases can be placed under already existing forms, as may easily be done with Kahlbaum's cases of Heboïdophrenia.

Klinische Beiträge zur Melancholie. Prof. E. MENDEL. Allgem. Zeitsch. f. Psychiatrie. Bd. XLVI, H. 4, 1889.

Mendel divides melancholia into three classes. 1. The patients are troubled solely or most strikingly by fear and anxiety regarding the present or future conditions of their own bodies; here the perceptive feelings are almost exclusively concerned; generally there are hallucinations of the muscular feelings, and especially of the organic feelings. This form is almost unanimously called *melancholia hypochondriaca.* 2. The intellectual feelings are especially the ones concerned in the morbid process. The patients say that they have not a single bodily ill; that they should be before a judge and not a physician; that they have sinned against God and their fellow-men. Morbid sesations are present, but play a subordinate part. Here belongs the religious melancholia of the authors. Mendel would call this form *melancholia intellectualis.* 3. Finally, there is a series in which both the perceptive and intellectual feelings are changed by disease, termed by Mendel,*melancholia generalis.* These patients may think that their bodies are destroyed, and all within them destroyed, and that they thereby stand under judgment of God. *Melancholia generalis* usually develops out of primary *melancholia hypochondriaca,* more rarely out of *melancholia intellectualis.*

Melancholia attonita cum stupore is a sub-division of *melancholia generalis* on the conception that *melancholia attonita* is seen to develop itself directly out of intellectual melancholia. Diseased disturbances of the intellectual feelings may be recognized in this condition in many cases through single spoken words or single acts. Here Mendel would promise convalescence with almost certainty. In this form, on the side of the perceptive feelings are important disturbances which are bound up with hallucinations of the muscle feelings, and are the source of the condition of abnormal contractions of the muscles. Experiments in the production of the cataleptic condition in hypnosis point without doubt to the fact that cataleptic stiffness, like the waxy flexibility, is a reflex process from certain muscular feelings.

Analysis of 206 cases of melancholia observed by Mendel gives these results : Hypochondriacal melancholia, 36; intellectual melancholia 116; *melancholia generalis,* 54.

There were 84 men and 122 women as follows :—

MEN.		WOMEN.	
15—20 years	2	10—20 years	10
20—30 "	22	20—30 "	40
30—40 "	16	30—40 "	38
40—50 "	18	40—50 "	16
50—60 "	22	50—60 "	17
60—70 "	4	62 "	1
	84		122

Of the men 8 per cent., and of the woman 2½ per cent. were under 20

years. The disease is especially common between 20 and 30 years of age. In later years it is most frequent in men. Sixty per cent. were hereditarily predisposed, but with no difference as to form. The hypochondriacal form is most favorable for prognosis.

Regarding relapses, there is little given in literature. Krafft-Ebing states that of 100 recoveries. 25 per cent. return to an asylum. Hertz in 67 recoveries from psychoses found 31 relapses (41 per cent.). Mendel found 24 relapses in his 84 men and 46 relapses in 122 women, and is inclined to think that far more than half of those attacked with melancholia have relapses. Relapses are most frequent in the hypochondriacal form, less so in *melancholia generalis*, and proportionately least frequent in the intellectual form. Relapses generally did not occur before three years; rarely after one or two years; and as a rule there was a longer period, 6, 8, 10, 12 years; exceptionally 26 and 34 years. Repeated relapses were observed 4, 5 and 6 times; in the last cases, 5, 10, 20, 26, and 30 years after the first attack, showing that recoveries may occur after repeated attacks. Relapses usually followed the clinical picture of the first attack, the identical delusions even reappearing. One woman recovered, and after 12 years had general paresis.

Opium, especially morphine subcutaneously, was of most benefit in the intellectual form; it was of no use in the hypochondriacal form, and in many cases even produced an aggravation and increase of the melancholic symptoms.

Die Ueberschätzungsideen der Paranoia. Dr. L. Snell. Allgem. Zeitsch. f. Psych., Bd. XLVI, H. IV, 1889:

Since 1865, psychiatry has been indebted to Snell for his study on the third great group of psychical diseases, in which he advances the conception of *primäre Verrücktheit*, characterized by ideas of persecution founded on hallucinations and diseased sensations, by which, in contradiction to melancholia the self feeling is an exaggerated one. A further essential symptom of this form of disease is the appearance of delusions with the character of over-importance and ideas of grandeur, which may appear from the beginning, but generally only make themselves important later on, and in addition to the delusions of persecution produce a second series of delusional formations. From the vantage-ground of the one who was first to insist on the *primary* nature of these mental disturbances, it is eminently proper that Snell should review the history of the evolution of his conception into the *Paranoia* of to-day, which he accepts, while at the same time he enters a protest against what seems likely to become a growing evil, the tendency to apply the term to acute and curable cases. Misunderstandings have been brought about, he says, by confusing conditions of acute disease with the delusional formations in Paranoia, while he had only in mind the chronic form, and he claims with justice that all attempts to extend very much the notion of Paranoia have resulted in unclearness, so much the more since the definition of this form of disease in itself already presents so much difficulty. The French alienists have always conceded the primary origin of Paranoia, or at least the possibility of this, while on the other hand they have conceived the ideas of grandeur and the ideas of persecution as two different forms of disease. The later treatment of the subject by the Psychiatric Society of Paris shows, however, that the interdependence of these two symptom groups will be more and more recognized in France. The essential feature of Paranoia, according to Snell's researches, is the formation of delusions based on hallucinations, with the characteristics of injury and persecution. This symptom also remains in existence when the delusional formation with the character of over-importance is bound up with it.

The pure delusion of over-importance, without the delusion of perse-

cution, comes forth in many conditions of mental weakness, e. g.,
sometimes in general paresis, but never in Paranoia. The proportion of
ideas of over-importance in Paranoia is a very varied one, and Snell
reviews a series of cases of this disease, which indicate the different forms
of this proportion, with the following results :—(1) the ideas of over-
importance may fail entirely ; (2) they may appear from the beginning
of the disease at the same time with the ideas of persecution ; (3) they may
appear the same as in (2), and then retreat for a time, it may be months
or years, generally making themselves prominent later in a higher
degree; (4) they may appear, as in the ordinary relation, after a
longer or shorter time, months or years, added to the ideas of persecu-
tion, and continue bound up with these.

This constitutes Snell's idea of the relation of ideas of over-impor-
tance to ideas of persecution in Paranoia. It is manifestly one parent
disease-stem, from which both spring.

The germ of the over-importance lies in the way and manner in
which these patients conceive their imaginary persecutions ; while the
melancholy patient receives the persecutions which, according to his
opinion are imposed on him, humbly and comfortlessly, and holds his
own unworthiness and baseness to be the fault of all the misfortunes that
he fears, the paranoiac feels throughout that he is the blameless sacri-
fice to a wicked malice. A paranoiac may commit a murder, and after
it appear cold and unmoved at his act, feeling no repentance and no pity.
It is the morbidly raised feeling of self, the exaggerated subjectivity
which permits him so to feel and behave. The consciousness of disease,
present in melancholia, is wholly lacking in paranoia, and every feeling
of duty and love is subordinate to the merciless, hard egotism, without
limits or bounds. That under such conditions a glorification of the
personality of the patient builds itself up, that the delusion lays hold of
him, that he is a man of unbounded influence, a prince, an emperor, or a
prophet, is in some degree explicable. The whole direction of the
disease points to these results of self-importance, if hallucinations
indicate the special formation of ideas of grandeur. As Snell has shown
in the cases given and elsewhere, Paranoia does not always tread the
typical path. It may almost come to a stand still. The delusions and
hallucinations lose in these cases their formative power and force on the
disposition of the patient. They almost die out. Even if no recovery fol-
lows,—recovery in Paranoia, as is well known, is extremely rare,—yet a
period of quiet comes on, which for the patient himself and those
surrounding him is of the most beneficent effect.

In conclusion, Snell pleads that it is almost necessary to take refuge
in this Greek word *Paranoia*, since alienists cannot agree on an appel-
lation for this form of disease, the designations *Wahnsinn* and *Verrückt-
heit* standing almost diametrically opposed. For the quiet, measured
course of Paranoia, in which the formal side of the intellectual activity
appears so little changed that the uninformed person notices nothing
wrong, *Verrücktheit* appears in a degree insufficient, while the word
Wahnsinn for those conditions in which the delusion takes a wholly
dominant place may be used not without a certain degree of propriety.

Ueber die psychiatrische Nomenclatur "Verrücktheit" und "Wahnsinn."—
DR. RODA. Allgem. Zeitsch. f. Psych. Bd. XLVI, H. 4, 1889.

At the yearly session of the Union of German Alienists, June, 1889,
Dr. Roda brought up the ever-fruitful subject of the classification of the
chronic primary insanities. It would be an incalculable gain if a relative
agreement might be brought about as to what "*Wahnsinn*" and "*Ver-
rücktheit*" should individually mean, but there has been no agreement in
the past, and does not seem likely to be in the future. Roda reviews the
well-known history of the two terms and what they have signified to

Griesinger, Snell, Westphal, Hertz, Nasse, Schäfer, Kraepelin, Meynert, Mendel, Fritsch, Schüle and Krafft-Ebing.

In how confused a state the subject is, Roda shows by citing a case which would be classed by Mendel as *mania hallucinatoria*, by Westphal as acute *primäre Verrcüktheit*, by Krafft-Ebing as hallucinatory Wahnsinn, by Wille as confusion simply, and by Mayser as asthenic delirium, and so on through all the other authors. One can well imagine, says Roda, the state of mind of the beginner in the study of mental diseases in whose hands are placed the best and most commonly used text books.

Roda urges that the expressions "*Verrcüktheit*" and "*Wahnsinn*" be put in the background, and that for them the Greek word *Paranoia* be substituted, and would favor enlarging the boundaries of this word. The problem of chief importance in Psychiatry is how much or how little shall be included in the term *Paranoia*, of which Mendel proposes the following divisions:

1. Acute Paranoia, in which the hypochondriacal, hysterical and original paranoia would be reckoned.
2. Chronic primary Paranoia.
3. Acute hallucinatory Paranoia, in which for example the psychoses from inanition, of Krafft-Ebing, would be reckoned.
4. Cronic hallucinatory paranoia, and finally,
5. Secondary paranoia, the terminal or transformation stage from other psychical diseases.

As the less of two evils, it may perhaps be found necessary to give up paranoia as a special equivalent for *primäre* or *originäre Verrücktheit* and make these but a subdivision of paranoia on some such plan as Mendel suggests, but this can only be settled by future discussion.

IV.—CRIMINOLOGICAL.

By Arthur MacDonald, Ph. D.

In a report prepared by Lombroso for the International Penological Congress is the question whether it will be advisable to organize instruction in penal science. That is, by what means could there be added the positive study of the facts and questions of application, without interfering with the performance of duties, and without prejudice to the administration.

In our own country and Europe, both past and present, science and the university have not only done almost nothing, but have manifested little interest in criminological subjects. They have taken the position of the public that crime is a necessary and incurable evil, and so there is little use in troubling about it. Yet penitentiary and carcerial sciences are the most complicated, and most susceptible to instruction of all other sciences. To construct the most healthy, most economical and best adapted prison cell or workshop is a desideratum. The same is true as to the construction of women's prisons, houses of arrest for accused persons, innocent or guilty, and places for witnesses.

At present our jurists study law books much more than they do criminals; and yet perhaps one half of the time of our courts is confined to criminals. Criminals are considered by many jurists, prison employees and the public, as normal men, who are unlucky and unfortunate. The individual study of the criminal and crime is a necessity, if we are to be protected from ex-convicts, the most costly and the most dangerous class we have. But the criminal cannot be studied without being seen and examined. For the love of science and humanity, we permit the examination of the sick, of pregnant women by young men, manipulation in surgical clinics of fractured members; the visiting, examination and individual study of the insane, although these are sometimes

injurious to the insane. But the criminal may not receive visits, may not submit to an anthropometrical examination. Why should criminals be so privileged a class? An accused innocent person may have his name and life, with photograph, published in the newspapers; and yet objections are raised to the study of habitual criminals for scientific purposes.

Benedikt, a specialist in craniology at the University of Vienna, says, that to correct the criminal and protect society, the criminal must be studied scientifically. For this purpose, the universities, higher courts of justice and prisons should have places for instruction and investigation. The importance of scientific criminological study may be illustrated in one of its phases by the work at Elmira. If the system there succeeds in showing how a young man, who is weak, can be best educated physically, mentally and industrially for success in practical life, *a fortiori* will this system be applicable to most young men outside of prison. The pedagogical value of such work is clear. According to Lombroso's idea, criminological instruction should comprehend: (*a*) A theoretical part on law, ordinances and carcerial regulations, kinds of cells, etc.; (*b*) A study of criminal statistics, penal theories, conditional liberation, patronage, etc.; (*c*) Studies in criminal anthropology and psychiatry; (*d*) A wholly practical part, consisting of examination of the places of detention, cells, etc.

In order to understand what the scientific study of a criminal means, we give in detail, a very important table, drawn up by Benelli, Tamburini and Lombroso.

Generalities : Name, age, country, profession, civil state.

1. *Anthropometrical examination* : Development of skeleton, stature, development of muscular system, weight. Color: of skin, hair, iris, uniformly colored, double coloration, peripheral and central, non-uniformly colored, color predominant, color not predominant, beard. Piliferous system. Tatooing. Craniometry: face, height, bizygomatic diameter, facial type, facial index; nose : profile, dimensions, direction, anomalies; teeth: form, dimensions, anomalies; eyes; neck; thorax; lungs; heart; genital organs; disfigurements.

2. *Examination of sensibility:* Touch: electric current, left hand, right hand, tongue; aesthesiometer of Weber: right hand, left hand, tongue. Pain: "algomètre" of Lombroso: left and right hands, tongue. Sensibility: muscular, topographic, thermic, meteorological, magnetic, metallic, hypnotic, hypnotic credulity, visual, acoustic, olfactive, gustative, chromatic, sensual (generative); first sensual relations, aberrations. Anomalies.

3. *Examination of motility:* Voluntary movements : gait, speech, language, writing; reflexes; muscular force; dynamometry; manual skill; anomalies.

4. *Examination of vegetative functions:* Circulation, respiration, thermogeny; digestion; secretions: saliva, urine, sweat.

5. *Psychical examination :* Perception (illusions) ; ideation (hallucinations) ; reasoning; will (impulsion) ; memory; intelligence: works, writings; slang; conscience; sentiments: affective, moral, religious; passions; instincts; sleep; moral sense; habitual expression of physiognomy; psychometry; anomalies.

6. *Anamnestic examination :* Family, parents; state of family; daughters, sons; age of parents; history, diseases, crimes of parents. Precedents: education, instruction, intellectual development, political, diseases, traumatic accidents, crimes, habitual character, occupation preferred. Latest information: last crimes, cause of crime, repentance, admissions, nervous diseases and mental anomalies (inter-current); inquiries.

L'Homme de Génie, par CESARE LOMBROSO, précédé d'une préface de M. Ch. Richet. Paris, 1889. pp. 499.

This work is one of the most interesting, that has appeared on this subject for some time. It is placed under the head of criminology, because indirectly it throws light upon the idea of crime. The insane and the men of genius are outside of common humanity; one is below, the other above common mortals. But at the same time, the great and powerful genius of inventors, discoverers, sowers and creators of ideas is not in accord with irreproachable intellectual health. Certain psychological characteristics are common both to the insane and men of genius.

While no formal line can be drawn between men of genius and men of talent, yet the genius of Dante, Pascal, Shakespeare, Newton, Victor Hugo, Goethe, Leonardo de Vinci, Raphael and Napoleon is beyond question. These men differed from their surroundings, they put forth ideas impossible to men around them; originality is their indispensible characteristic. In this sense the man of genius is abnormal. The genius can find those associations of ideas, which do not appear to others, and in this he is strange and abnormal, an exception. The same is true of the insane; in them the associations of original ideas abound; they are often ridiculous,but always unforeseen and sometimes ingenious; the insane are different from their contemporaries; they are abnormal, exceptions. Nature does not love exceptions, she endeavors to cause them to disappear, she is above all solicitous for the uniformity of the race, she is democratic and leveling. In studying closely the characters of superior men, we rarely miss finding in their mental organism and intellectual processes something defective, morbid, pathological. Great men have fixed ideas, prejudices, moral perversities, constitutional vices, gaps in reasoning, sometimes hallucinations and delirious ideas. Pride, sensibility, moral irritability, fear are some of the affections of soul in them, which sometimes assume an unhealthy exaggeration. Women should never be advised to marry them, because these psychical characteristics reappear with force in their descendents.

In every work of genius we find something spontaneous that baffles the common ideas, either by audacity, or vigor or unforeseenness; long patience can produce something moderate and honorable; but genius produces the immoderate, the extraordinary, the strange. It is exactly this character of strangeness which is found in the thought of the insane. Especially in poets do we find a promptitude, an oddness, a preposterousness of associations of ideas. The insane proceed by puns, by alliterations. In the great inventors as in the poets, the idea is almost always involuntary, sometimes uncouth and surprising. The insane give birth to gorgeous inventions. Rationa men confound great inventions with those of the insane. In fact, great inventors have been ridiculed by the public. Napoleon considered Fulton as insane. The Academy of Sciences at Paris doubted the reality of the telephone; great inventions like the lucubrations of the insane are above our ordinary conceptions. True, the genius has the rapid and strange conception of the insane man; but he has something more that makes his conception fertile, instead of sterile and absurd; he has clearness and expansion.

Most men live in a half-dreamy state, are incapable of seizing the relations of objects around them, are on the surface of things, and faithfully follow their dream. The insane have this intellectual infirmity still more; they live a full dreamy life. Insanity is the outpouring of a dream into real live. Men of genius, having an ardent imagination, separating them from the crowd, have at the same time a great critical sense, which is exercised immediately, and with creative ideation. The mingling of the critical and inventive spirit gives them

their power. In the last analysis the genius differs from the insane man, in having not only a single association of ideas, but almost an infinite series of ideas: and, still more important, the vastness of his intelligence permits him to correct the wildness of his imagination. The genius then, is original and abnormal, but has a critical mind. The insane man is original, but lacks the critical spirit. The ordinary man has some critical spirit, but lacks originality.

For example, Don Quixote has large and fertile ideas. He is a great renovator, an ardent soul, enamoured of good and justice. In everything he has astonishing notions, superior to the common opinions of his contemporaries. He conceives quickly, invents associations of strange ideas. He has the invention of discoverers and men of genius. A little more practical spirit, and he would reform humanity. But, alas, he is insane, and truly so, since the faintest trace of critical spirit is wanting in him. He renders no account of real things, he is in the clouds; he takes his imaginations for verities, sees everything through his dream, walks like a somnambulist in common life. He cannot arrive at anything; he is destined to finish in an insane asylum, notwithstanding his efforts, his courage and his power of audacious conceptions. The works of Edgar Poe are full of the fantastic element, invention, original creation, association of extraordinary ideas, which dominate absolutely over the critical side. Poe was somewhat dipsomaniac and even alchoholic. His works are remarkable, nevertheless they resemble the wanderings of a maniac. But how shall there be a defence against the sentiment of horror in associating those who represent the highest manifestations of the human mind with idiots and criminals?

In some late teratological researches of Gegenbauer, it is shown that atavistic regression does not always indicate a real degradation, but is often compensated for by a development in other directions. Apes and quadrupeds possess a larger number of muscles than we; but by losing their advantages we have gained intellectual superiority. Giants pay for their stature by sterility and a relative feebleness of intelligence; so genius expiates its intellectual power through degeneracy and psychosis, and it is for this reason that the signs of degeneracy are more often found in genius than in insanity. But it may be objected that it is not necessary to refute the hypothesis of insanity in genius, because force is not feebleness, health is not disease; and the cases are merely exceptional. The answer is that the physician knows very often, that force in fever, in delirium, in epilepsy is an index of disease. As to the second objection, the facts are sufficiently numerous.

Aristotle says that under the influence of a congestion of the head, there are persons who become poets, prophets and sibyls. Plato affirms, that delirium is not an evil but a great benefaction, when it eminates from the divinity. Democritus makes insanity an essential condition of poetry. Diderot says, "Oh how close the insane and the genius touch; they are imprisoned and enchained; or, statues are raised to them." There is philological evidence in the Hebrew words, *wavi mesugan* and the Sanscrit *nigrata* that the ideas of insanity and prophecy were mingled.

Some of the geniuses who were insane are Southey, Poe, Comte, Swift, Newton and Rousseau; those who led a vagabond life are Heine, Byron, Leopardi, Goldsmith, Musset, Petrarch, Cervantes; those given to alchoholism are, Alexander, Poe, Addison, Goldsmith, Burns, Coleridge, Handel; those morally insane are Sallust, Democritus, Plato, George Sand, Byron, Carlyle; those who were epileptic are Montesquieu, Buffon, Chateaubriand, Napoleon, Peter the Great, Julius Cæsar, Molière, Charles V, Schiller; those with double personalities are Shakespeare, Dryden, Bruno, Renan, Pascal; those with melancholia are Goethe, Leopardi, Molière, Mozart, Chopin, J. S. Mill; those who

attempted suicide are Zeno, Aristotle, Lucretius, Rousseau; those who had a mania of greatness are Hegel,(who said : " I can say with Christ not only, that I teach the truth, but I am myself the truth,") and Comte who thought he was the High Priest of humanity. In the words of Aristotle : " *Nullum magnum ingenium sine quadam mixtura dementiæ.*"

The most complete type of insanity in genius is Schopenhauer. He says himself that his intelligence came from his mother, an authoress full of vivacity, but without heart; while his character was transmitted from his father, a banker, misanthropic and bizarre even to *lypémanie.* He was hard of hearing from youth. In spite of changing scenes and voyaging, he lived without gaiety. He often gave vent to his discontentment. The Alps gave him a deep sadness. Owing to his temperament he could not live with his mother. He passed rapidly from profound sadness to excessive joy. He described men as "bread-soup soaked in water with a little arsenic;" and man's egotism as like to that, "which unites a dog to his master." He confessed, that when he composed his great work, he carried himself strangely, and was taken for insane. He had a very distinct apparition, accompanied with a psychical affection, he passed weeks in a state of profound sadness without seeing anyone. From infancy he had the mania of greatness, melancholia and the idea of persecution. He was afraid of a razor; a cup not his own could communicate a contagious disease. He was occupied always with himself " creator of a new system." He said, that men of genius are often like the insane, given to continual agitation. Hearing his landlady talking in an anteroom, he went and shook her so severely as to break her arm.

If it be objected to our author's view, that it is cruel to compare all that we consider highest in the world with insanity or criminality, it may be answered, that we might as well deny beauty to the lily, because it grows in a marsh; as well say, that botanical analysis destroys the fragrance of a plant, or object to classing man among the bipeds, because vultures and other birds are so named. The genesis and evolution of an object does not change the present nature of the object. If man came from the lower animals, it is no dishonor. What man is, is what elevates him, not where he came from. Any analysis of genius, that may show the closest relation to insanity or crime, cannot change genius itself. It might be said, that it is rather to the credit of genius, to come so near insanity, and yet not be it. The question is not a matter of sentiment, but of facts.

We might classify men into geniuses, insane, criminal and normal. We may say, that the genius is more like the insane than any other class of men, and the most divergent from the normal man; that the insane is more unlike the normal man than the criminal is. Considering all the characteristics of the criminal he is the nearest allied to the normal man, but in one characteristic he is the most distant from the normal man; that is, in a feebleness or want of moral sense. As the genius can be a monster of intellectual development, so the criminal can be a monster in immorality. The criminal is the only one, who can be a member of all these classes. Lacernaire, a celebrated criminal, was a genius. Geniuses, who were criminals, are Bacon, Seneca, Rousseau and Donizetti.

Hypnotism and Crime, DR. J. M. CHARCOT. The Forum, April, 1890.

There is comparatively little written on criminal hypnotism. The ideas as set forth by the originator and leader of the Paris school are of all the more interest. Persons susceptible of hypnotization are nervous and capable of becoming hysterical, if not actually so at the beginning of the experiments. Hypnotism and hysteria are near akin. Hypnotism is a genuine neurosis, not a physiological state. There are

three states: lethargy, catalepsy and somnambulism; in the first two, particularly in lethargy, there is absolute unconsciousness, the subject is motionless, his will in abeyance, there is no suggestibility. In the third state, the subject hears, sees, receives and carries out suggestions given him by the one who hypnotized him. An important fact is, that on awaking he recollects, outside of the suggestion given him, nothing that has happened during the sleep; but he will recollect it in a second period of hypnotic somnambulism, unless a contradictory suggestion be given. This loss and this recovery of recollection under fixed conditions is important in medico-legal hypnotism.

Rape and attempts at rape are the most frequent crimes upon hypnotized persons. Gilles de la Tourette is able to cite five cases of this class, developed in action at law; not a small number, considering the difficulties of detection. The problem to be solved is this: "Given the suggestibility of a somnambule, can one use him to do a criminal act to which he would never have consented outside of the hypnotic sleep?" Suppose a subject put to sleep, and in the somnambulic state he is told: "You know A; he is a contemptible fellow and is ever trying to injure you. He must be put out of the way. Here is a dagger, to-morrow you will go to his house and stab him. You are not to remember that I ordered you to kill him, even if you be hypnotized again." This can be done in the laboratory.

But some subjects refuse to obey; the training of subjects is not easy, it takes time; and suitable subjects are not numerous. Suppose the subject is already to act, but the victim does not pass, what happens? In most cases a fit of hysteria; or an attack of acute delirium, or of babbling mania. Thus, it is as important that the conditions be realized, as that the suggestion be accepted. Now, no one has been able to discover one single crime of this kind actually committed in real life. A criminal desires first of all to escape punishment; he will not make sure of his revenge and conceal himself from prosecution by putting a weapon in the hand of a lunatic somnambule. Suppose a somnambule signs a check; on awaking he will hardly part with his property without protest. He will ask himself how he came to sign such a paper; an investigation might be embarrasing to the holder of the check. Although the courts will seldom be called upon to consider crimes committed by somnambules or upon somnambules, yet there is danger in another direction, that is, in the injurious effects of ill-advised hypnotizations by persons who are not physicians. We can track a "showman magnetizer" by the persons he succeeded with, who become nervous and irritable; some fall into deep sleep out of which it is difficult to bring them; they are unfitted for duties of daily life. Others, and they are the majority, have convulsions resembling the crises of confirmed hysteria. Hypnotism should be confined to the medical profession. The expert in court has to inquire if the subject has an affection capable of coming from ill-advised hypnotism. He ought not to go beyond the formula: "The individual can (or cannot) be put into the hypnotic state."

Les Suggestions Criminelles, Leçons professées à la Faculté de Nancy, par M. le Professor BERNHEIM. Revue de l'Hypnotisme, 1er Mars, 1890.

This article, written by the leader of the Nancy school, brings out clearly the main point of difference between the two schools. Free will and responsibility are problems that present themselves to us. We are all suggestible in a certain measure; our reason leaves us sometimes; evil thoughts creep into our imagination out of our control; the thought tends to become an act. To what degree can we resist this tendency? Can it not impose upon us the law of ideo-motor or ideo-dynamic automatism, which transforms the idea into action? Can

crimes be committed by suggestion? The Nancy school replies affirm-atively. Liébeault, Liégeois, Beaunis and Bernheim say that certain somnambulists can under the influence of suggestion, either during sleep, or after wakening, execute with docility what they have been ordered. Numerous experiments should carry conviction.

The Paris school, with Charcot its eminent head, Brouardel and Gilles de la Tourette, reply in the negative. It is said that the crimes we cause to be committed are those of the laboratory; that if we give to a man a paper knife to kill his neighbor with, he knows that the knife is harmless; his confidence in us renders him obedient to the suggestion. This is true in certain cases; the somnambulist knows it is a representation, and plays the comedy which we desire him to play. It is sometimes so in natural dreams; we know that we dream; we dream passively; we endure the most terrifying things, without feel-ing any emotion; the heart-beat and respiration are not accelerated; we are indifferent to the drama in which we are actors; the individual is as if he had to do with another of his selves; the conscious being is awake by the side of the new being, the sub-conscious. The feeling of our identity is stronger than that of the hallucination, which strikes our sensation without reaching the moral foundation of our being. The same is true of certain hypnotized persons. I say to the subject, the dog will bite you, but he puts his hand upon the dog without the least dread. Other subjects resist suggestions; they retain a certain initia-tive. I command him to steal a watch, but he refuses; his moral character is a primordial anterior suggestion that neutralizes these other suggestions. But there are others, who have no power of resistance; the sub-conscious in them annihilates their conscious being; these will commit crime. So in natural sleep, we have dreams, in which we are not ourselves; we fall from a precipice, we are terrified, respiration is anxious, the face pale, we groan in our sleep. There are a sufficient number of cases, where crime has been committed during natural somnambulism. Can this not be true in provoked somnam-bulism?

The author gives the case of a young artist to whom he had suggested to steal his watch, when he should awake; which he did without hesitat-ing; and when discovered, was confused, trembling, imploring them not to arrest him; this latter was a real emotion; the subject was honest by nature. Among somnambulists who act post-hypnotically, there are some who do it as impulsive epileptics. Sometimes the epileptic knows that he kills, but does not know why. The insane sometimes say: "I have a foolish idea to set fire to the house, or kill my child." Why, to what purpose? Do you not love your child? "Yes, I love him, I know it is wrong, I have no reason to kill him." In hypnotism a similar psychical state is realizable; it is a blind instinctive impulsion, without reason; it is an impulsive insanity. There are others who do not act abruptly. The operator said to one during his sleep, "When you awake you will steal my purse on the table." On awaking he did. He was asked, "Why have you stolen?" He answers, "It is to take what you owe me, I lent you some money and you have not returned it, it is a restitution, not a theft." In this case I did not produce a perversion of the moral sense. Imagination turned the difficulty; it suggested to the subject a retroactive illusory memory through which the theft became allowable. To the subject was said: "Here is a pistol and when you awake you will shoot this man." On awaking he does it. I ask him why. He replies, that the man insulted him, had pointed a pistol at him; so he defended himself. Hallucination like imagination furnishes a rational pretext. This hallucination can be created, if auto-sugges-tion does not interfere. One can say to the patient: "Here is a man who has seduced your wife; when you awake you will avenge your

honor and kill him." It would be still easier to suggest crime to those who love it, because there is no moral conscience to reject the suggestion. It is difficult to say, whether a person with a developed moral sense, could be directly so enfeebled or perverted as to commit a crime. But it is certain, that an honest man can, when carried along by an impulsive giddiness, delirious idea or hallucination. The nihilists, anarchists, socialists, revolutionists can become criminals by suggestion. The excited crowd, hearing the word, "spy," "traitor," become ferocious and bloody and rush upon some innocent person. It is a collective suggestion, a blind passion that carries the masses. The brute nature is unchained.

It has been objected. that there is not on record a case of crime committed under the influence of hypnotic suggestion. This is possible; hypnotizers are not generally criminals. But if a hypnotizer was a criminal. he would not tell it to the person he hypnotized, much less to anyone else. The truth is, suggestion plays a rôle in many crimes. There is hypnosis without sleep; suggestion can occur during the waking state; some persons are normally very suggestible; a word can produce in them analgesia, catalepsy, hallucinations, acts; the suggestion is made without their knowledge, and sometimes the suggester is unknown to them.

These ideas find their application: A young lady of good principles, honest and of sweet disposition marries. The first years are happy. A young man gains control of her. Her husband involved in difficulties for subsistence neglects her. Later her husband meditates vengeance against this young man, who, having seduced his wife, established a rival business, which prospered, while his own was in peril. To satisfy his vengeance he gained again the heart of his wife; and persuades her that his rival is the cause of their trouble; and hints that he ought to be killed. Docile and yielding to threats, she arranges a meeting with her lover under the pretext of renewing old friendships. She goes there; she enters the "Madeleine" to pray; then coldly, without emotion, she conducts her lover to her husband, who assassinates him. No regret, no remorse troubles her conscience. Nothing in her antecedents had indicated such monstrous moral perversity. Before the jury, the matron of her " pension " testified to her sweetness of disposition. Another testified she was like soft dough; she went to vice as well as to virtue. Her brain was open to all suggestions.

L'Alcoholismo, sue conseguenze morali e sue cause. Dr. NAPOLEONE COLAJANNI. Catania, 1887, pp. 203.

Alcoholism is most ancient; it has infected barbarous and civilized peoples; it was not a politico-social question. In modern times there is the greatest uncertainty concerning this question. The most fallacious statistical method to resort to is that of averages. For the quantity of wine produced in a country is given without deducting the part exported; and the comparison should be between the production of one year and the crime and suicide of the year following, in which ten twelfths is consumed, and not of the same year.

The official statistics of France and Italy indicate that alcoholism, as a direct motive of crime, is very, very limited. Comparing the first year of observation with the last, there is everywhere a perfect parallelism between the increase of alcoholism and that of crime and suicide; but the increase of crime is for the most part apparent, while that of suicide is real, continuous and without numerous oscillations, which characterize the increase of alcoholism and crime. On this account alcoholism increases in the inferior classes; suicide in the cultured classes. A slight increase in consumption of alcohol often corresponds to a large increase in crime, and *vice versa*. The maximum

or minimum of alcoholism does not correspond once with the maximum or minimum of crime and suicide. Alcoholic intoxication makes the sentiments of man neither worse nor better; but it lets them loose, it accents them, it reveals them in their naked truth. Well established cases of insane or criminal descendents through alcoholism do not authorize one to generalize this fact. There is wanting between alcoholism, crime and suicide constancy, regularity, and universality of relation, of coincidence and of succession; therefore the relation of cause and effect cannot be established between them, according to the laws of statistics.

Among the more authoritative writers, the opinion prevails, that alcoholic beverages, which are concentrated or of bad quality, injure the physical and moral health; but that the consumption of wine, (the most innocent of alcoholic beverages), day by day and year by year, cannot be shown to be a true and efficient cause of crime. The conditions that favor the increase of alcoholism are physical, economical and psycho-social. Climate is the most important cause of all; is constant and independent of human action.

All physiologists recognize that alcohol increases the circulation, excites the intellectual faculties, and aids and stimulates the action of the digestive organs, and that it produces these beneficial effects in the shortest time, and with the least cost. An inquiry into the conditions that favor or determine alcoholism admits but of one conclusion: that in its morbid conditions, it is a product of the social organization. When this organization is opportune, and conformable to equity, it is more beneficial than the influence of climate. The principal remedy for drunkenness is of an economical and social order. We must interest the laborer in organizing his work better; we must favor for each family the possession, first of moveables, and then of a habitation; we must multiply indefinitely artistic distractions and encourage intellectual recreations.

On the whole, this author represents the opinion of Europe as to alcoholism. It seems to us, however, that the question may be somewhat different in America. For one of the most apparent and real differences is the fastness of growth, which has become rooted in the American nature. Thus as a nation we walk, run, travel, eat and drink faster than the Europeans. This drinking fast and often, without eating, and often when not thirsty, together with the unfortunate habit of treating, are conditions in our social organism, which make so much more drunkenness visible. It is also true that a majority of our drunkards are not Americans.

Experiments as to the action of Alcohol on the Brain. J. J. RIDGE. Physician to the London Temperance Hospital. Quarterly Journal of Inebriety, Jan., 1890.

A narcotic cannot become general in use without injuring the race. Any one of the narcotics habitually used so alters the nervous system as to cause uneasy sensations when abstained from. Alcohol is no exception to this rule. Insurance societies are proving what the influence of alcohol on the race is. As to the individual, it has been shown in a former paper that the sense of sight, common sensations and the muscular sense are blunted by alcohol in doses from two to four drachms. Dr. Hughlings Jackson agrees that those powers of mind developed last are the least stable and the first to be paralyzed by alcohol. Dr. Kraepelin in a series of experiments has shown that alcohol prolongs the simple reaction time, and the time for discrimination and decision. While then, the influence of alcohol upon the psychical processes makes them slower, the individual believes them to be much quicker. This illusion shows most rationally the necessity for abstinence. Alcohol,

then, injures the capacity for self-control or temperance, which cannot be as great or complete with alcohol as without it.

El Craneo y la Locura. DR. W. RODRINGUEZ. Buenos-Ayres, 1888.

The purpose of the book is to study the relations between the form of the cranium and mental diseases. The results are from the study of 532 cases. These might be questioned, since an apparatus called the conformitor (used by hatters), was employed in obtaining the anterior-posterior and bilateral diameters with the aid of Broca's compass. The form of the cranium is an important element in the diagnosis of insanity. The majority of cases show a striking asymmetry; there is a marked predominance in the lateral posterior regions. In the maniacs the anterior-posterior diameter is greater than the average. In cases of dementia, there is a twisting movement of the head with an exaggerated development of the parietal eminences. There is always a predominance of the frontal lobes in the general paralytics. In idiots and cretins the lines which form the contour of the head are very irregular; there is also an exaggerated development of the occipital protuberance. The author is consulting physician and director of the Argentine Medical Society for nervous diseases. It is interesting to hear what an authority from South America says.

La Contagion du Meurtre, étude anthropologique criminelle. Le Dr. PAUL AUBRY. Paris, 1888. pp. 184.

The phenomenon of morbid psychology, which the author considers, is a combination of suggestion, imitation, heredity and contagion. Contagion may arise from family influence, as in the case of the child raised in crime, who sees his parents profit from it; or it may come from contact with prisoners. If the child goes to the house of correction, the case is no better, as contagion has a hold on him. A good man rarely comes from a criminal family, but a bad man frequently comes from a good family. Reformation from prison life is a myth. Lacenaire, a most celebrated criminal, himself says : when a young man enters prison and hears of the grand exploits of the others, he regrets that he had not been a greater criminal himself. Contagion comes from public executions; those who quit the prison assemble at public executions to see the blood, which for them has special attraction. Out of 177 persons condemned to death only three had not been present at other executions. The indirect contagion of the press is an established fact. In 1885, in Geneva, Switzerland, a woman killed her four children, then tried to commit suicide; in her autobiography were these words, "As a woman did it, which was in the newspaper." Tropman, a celebrated criminal, confessed that the cause of his demoralization, was the reading of novels by which he developed a strong passion for heroes of the prison. If such reading influences a sound mind, its effect on the weak minded and insane is still worse. The reading of the details of crime first produces repulsion, then indifference; soon crime is looked upon with complacency, and after this, overt acts may follow with less difficulty.

There is the contagion to vitriolize or to use the revolver. A woman wishes simply to disfigure some enemy; she has read in the paper how another woman accomplished this and was acquitted with the congratulations of the jury and with public applause, how everyone talked about her, how her picture was in the paper; she finds vitriolizing convenient, and imitates her model. Those who use the pistol are not so contemptible as the vitriolizers, though the results may be more fatal. Poisoning was once the royal and aristocratic mode of disposing of persons, but owing to the advancement of chemical science, it is now comparatively infrequent, and if resorted to, it is generally by the

ignorant. In infanticide the mother was accustomed to place her hand over the mouth and nose of the infant, but the newspapers showed the danger of this method; so at present the child is strangled under a pillow or blanket, which leaves no traces. Mutilation and incineration often follow each other. It is natural to assassins to cut a body into pieces, as it is easier to dispose of it.

Epidemic and endemic murder are frequent in great social disorders, as in the French Revolution and the Paris Commune; the sight of blood in a crowd is contagious, excitement follows, then concentration on one idea, which demands victims. War is a neurosis, in which people rise in a mass, it is a contagion that affects all minds, and acute in nature; it is a homicidal insanity. Violation followed by murder is a local epidemic. A band of young men after more or less drinking, meet on an isolated route a woman, it matters not whether old or young; they maltreat and violate her; their wantonness being appeased, it changes into homicidal furor, they urge one another on; they not only kill their victim brutally, but make her suffer.

The author after giving numerous illustrations makes the following general conclusions: The idea of murder is essentially contagious; in order to be manifested, two factors are necessary, (1) heredity or degeneracy, (2) education, by which is understood the action of examples, the description of crime, etc. The prophylaxy of murder rests: 1, in the moralization of customs; 2, in the regulation of the accounts of crimes given by the press; 3, in a more logical severity in the courts; 4, in a more moral and individual hygiene.

Du Dépeçage Criminel. A. LACASSAGNE. Archives de l'Anthropologie Criminelle. Tome troisième, 1888.

The author is one of the most distinguished medical legalists in France. "Dépeçage" (διὰ-τέμνω, I cut through), is the act of cutting a body into more or less equal portions. Criminal "dépeçage" is the act of cutting the human body into an indefinite number of fragments for the purpose of disposing of the victim and of rendering his identification more difficult. Sometimes the head, the arms, the limbs and trunk are separated; or they may be reduced to pieces. This method of the assassins has become the style; it is by imitation, made contagious in feeble and hesitating individuals through detailed descriptions by the press. They seek the methods that will make the greatest difficulties for justice. In inquests, care must be taken not to suggest to the guilty machiavelian plans; since their minds are very simple, and too impulsive to carry out combinations. The magistrate or physician should try to think as they do, and always by making the most simple hypothesis.

The advancement made in constituting identity has caused the criminals to take more precautions. Thus an assassin says that if he killed anyone, he would strike him on the head, then he would skin him as a calf, cut off his ears and nose, and take out his eyes so that he could not be recognized, and cut his body into pieces and scatter it here and there.

This form of bestiality is the most genuine mark of the destructive instinct. This is not in obedience to the laws of atavism. But it is because these criminals are as they are, that we call them an arrested type; since the most ancient times, their instincts have remained the same; and since they have few ideas, they are necessarily destined to imitation.

Historical anthropology distinguishes religious "dépeçage" or sacrifice from judicial "dépeçage" or torture. To appease divine anger, children were offered; after victory, the prisoners were sacrificed and eaten. There is a sort of pathological cannibalism as in famines and popular tumults, manifested through a perversion of taste and excitation of destructive instinct. In judicial cannibalism, after sentence, two

or three days are given the people to assemble; the party offended has his first choice, and cuts it from the living victim; then follow the others according to their social ranks, and cut according to their preference. In the middle ages crimes against royal persons were punished by quartering the guilty; sometimes the wrists or feet were cut off before execution. In all times criminals or despots have had the cruel fancy of mutilating their victims.

The author presents an instructive table giving the observations of forty cases. The practice most common is where the assassin after the homicide, greatly excited and out of himself, begins at once to section the head, to make sure of death, and to do away with the part most liable to cause recognition; then follow the inferior and superior members. Sometimes fatigued by the struggle and the emotion, the assassin waits till the next day, sleeping soundly during the night.

Dépeçage can be practiced in case of accidental death, by dismemberment for conveniently carrying the body. Some aids in examination are: the teeth, surface of body, length and color of hair, scars, tattooing; wounds by both fire-arms and knife, indicating more than one operation; or some parts well sectioned and others badly; direction of the cuts, showing left or right-handed person; way of tying knots, packing or sewing, indicating a sailor or a woman; way of disarticulation, indicating a cook; bloody hands, direction of the drops of blood, instruments stained, or clothes torn or stained; general disorder in location; rate of putrifaction, especially rapid in those succumbing from great fatigue; if cut soon after death, there is hemorrhage, so putrifaction is slow; but it is rapid if "dépeçage" is long delayed; the flow, coagulation, and infiltration of blood, and separation of the wound leave no doubt. If there are traces of inflammation, or change of color of the ecchymoses, these indicate that the wounds were made during life.

Although the publication of such details provokes imitation, or forces the murderer to improve his methods; yet observations are reunited, compared and commented upon; this is a compensation, and can be utilized by the state.

Le Crime en pays Créoles. Dr. A. CORRE. Paris, 1889. pp. 314.

This book is a sketch in criminal ethnography. It is a natural history of crime; but of distinct races under metropolitan assimilation. The author gives a general insight into the evolution of delinquency and crime among the Creoles inhabiting Martinique, Guadeloupe and Gugane in the Atlantic ocean, and Réunion in the Indian ocean. These contain in all 450,000 inhabitants, of whom one tenth is white. There are the black Creole as distinguished from the black Africans; the white Creoles and the white Europeans, and a mongrel race coming from the union of these.

Criminality here is influenced rather by the social conditions than by racial factors. In the time of slavery the negro, a passive and almost negative being, committed less crime than the white man. At the time of emancipation the blacks gave themselves to abominable acts; the white population was so reduced as to have scarcely any influence on crime. The colored population increased in power as the field of its appetites enlarged. Criminality increased proportionally to the population, however. If social development is a cause of crime, it is also a corrector and reducer of dangerous impulses through the collective education on which it reposes. Emancipation certainly ameliorated the negro. But assimilation makes the number of crimes formidable, for in a rapid evolution the weak and impotent, remaining behind, furnish the largest number of criminals. The negro and white man have distinct physical organizations, and as a result distinct social aptitudes. The most advanced social organization is not comprehended by the

negro; **extreme liberty** without the control of the white man brings him back almost to the ancestral savagery. The negro kills with little or no premeditation; is sure to obey the sexual appetite; is seldom guilty of infanticide or any atrocious suppression of descendents. The negro is very tolerant, has few needs which oblige him to struggle; is contented, if he can be lazy.

The Hindoos are isolated from the Creoles, but not in castes; their offences show a certain degenerative refinement in motive or execution; they will not submit to tyranny of masters; debauch, adultery and jealous rivalries involve them in their worst offences; they learn skill and foresight, and are almost professionals in crime. Creolian and Hindoo criminalities conserve their own ethnic and sociological characteristics. The author concludes this study in criminal ethnography by giving a detailed enumeration of measurements and observations to be made in the anthropological study (properly speaking) of colonial criminality.

De la Criminalité en France et en Italie; étude médico-légale. DR. ALBERT BOURNET. Paris, 1884. pp. 153.

The author is a pupil of Lacassagne. The book is important as treating of the statistical criminology of France and Italy. The following are some of the general conclusions:—

1. In France criminality has more than tripled; this increase is due especially to the modifications of legislation; crimes against the person have varied little, but rather increased than diminished. Corsica, where crimes are still very frequent, is a veritable disturbing element. Crimes against property are diminishing.

2. In Italy crimes of blood are three times more numerous than in France, and murder is six times as frequent.

3. Assassination is on the increase in France, while in Italy it is diminishing; yet it remains twice as frequent as in France.

4. There is a notable diminution in poisonings in both countries, the number being the same in the two countries.

5. Violations and crimes against chastity are infinitely less frequent in Italy. In France these crimes are increasing at a frightful rate, especially among children.

5. In France infanticide is twice as frequent as in Italy; while parricide is twice as frequent in Italy as in France. Abortion is about the same in both countries.

7. In France and Italy the law of antagonism between suicides and crimes of blood is manifest; in France suicide has been constantly increasing, especially in the army, where it has doubled within the last ten years.

Ueber die Körperlichen und geistigen Eigenthümlichkeiten der Verbrecher. DR. v. HÖLDER. Archiv für Anthropologie, Januar, 1889.

The writer gives a short survey of facts taken from his varied and extensive experience as guardian of the insane and administrator of penal justice and prisons. His craniological remarks and his distinctions between insanity and criminality are especially valuable.

Though many characteristics are common to the insane and criminal, one is not justified in doing away with freedom of will; for criminals are not sick, like the insane. It is impossible from cranial asymmetries to conclude as to psychical characteristics. Physical signs of degeneration indicate nothing further than the presence of a tendency to psychical degeneration. It is scarcely a pardonable error to consider every man with these characteristics as a predestined criminal, as some of the Italian school would do (Garofalo).

The great influence of occupation, education, poverty, rough-handling and misery is self-evident. In such cases, where the tendency has

a certain intensity, deformations and even physiognomical peculiarities form an important factor in patho-psychical degeneration. The most important of these symptoms are found in the head and genital organs. Most of the characteristics come from the premature growing together of the sutures. The dropsy of the pia mater can enlarge the cranium in all directions, so long as the sutures in childhood are capable of considerable extension; in the later growth of the edges the coronal suture remains an annular transverse depression from rachitis; a further misformation from the same cause is a flattening or deep depression around the occipital fossa. The inferior degrees of asymmetry of the two lateral cranial sides occur without the premature growing together of the sutures. This is mostly hereditary. The tying up of the head, as practiced in the south of France has no influence on psychical development. If several sutures grow together in fœtal life or soon after birth, as in idiots, the form of the cranium is little changed; except it remains microcephalic. If the premature closing of several sutures occurs at the same time; if the height increases at the expense of the width, the head becomes pointed; if the breadth is at the cost of the height, we have a pathological flat head. Premature closing of the frontal suture makes it smaller, low and flat, and causes the orbital arches to project out. The closing of the sagittal suture makes the cranium very long, small and high; both these forms are more frequent in dolichocephaly than in brachycephaly. By the closing of half of the coronal suture, a crooked growth of the cranial roof takes place which in its highest degree produces a kidney-shaped form (plagiocephaly.) The closing of one side of the occipital suture makes the corresponding side flatter than the other.

These misformations are accompanied by those of the face. There is the bird face of the microcephalic heads, and the flattened upper part of the face of the pointed heads; further a high degree of asymmetry of both sides of the face; the bent and flattened nose; so the asymmetry of the orbits; here belong the cases where the under jaw projects beyond the upper; also vice-versa; also the bending of both rows of teeth; the gums are often too flat, too wide and too small; squinting of the eyes, division of the iris; and sometimes skin duplicature in the corners of the eyes reminds one of the mongolian duplicature. The signs of degeneration in the ears are their smallness, great length or want of developed muscles; and very small laps, that grow on.

The deformations of the genital parts have a special diagnostic value, because a part of them in both sexes leads to sexual disorders of every nature, which are causes of mental troubles. The most frequent deformations are: atrophy of the testicles, phimosis, stunted or deformed penis; fissure forms of the urethra, growing together of the penis with the scrotum, hypertrophy of the clitoris, closing of the back part of the vagina. Stunted growth, club foot and corresponding deformations in arms and hands are seen in the skeleton.

The lowest degree of all these deformations are directly connected with individual oscillations within the sphere of normality. Dr. Seiffer from the examination of a large number of criminals found 47 per cent. with at least one of these signs of degeneration; 10 per cent. had cranial and facial anomalies. These deformations are rarely greater in criminals than in normal men, except in criminal idiots or cretins. Physiognomy stands in close relation with facial and cranial signs of degeneration. Habits however have great influence; the passage to prison physiognomy is gradual. In prison garb a face makes quite a different impression. Some criminals change their looks very much. Out of 1022 portraits it was impossible in many cases to pronounce one a criminal from his physiognomy; one will see the features of the insane.

There are two classes of criminals: 1st, criminals by occasion; 2nd, recidivists. The basis of all criminality is irradicable tendency to lying. Men furnish almost six times as many criminals as women; it is easier for men to overstep the bounds of morality and custom. Most women criminals loose every trace of womanhood in demeanor. Criminals by occasion are those who become so through levity, passion, imprudence, unfavorable surroundings and above all through abuse of alcohol. According to Baer 50 per cent. of all crime comes from alcohol; three-fourths are crimes against the person, and only one-fourth against property; while the reverse is true with the recidivists. Minor criminals are to a large extent capable of improvement. To accomplish this, the perversity and exceptionableness of their actions must be recognized. The infanticides are the best of all criminals. The recidivists should be divided into two classes: one class includes those, who for the most part have no mental or bodily signs of degeneration, caused by bad bringing up, society, poverty, sexual disorders; and those who make crime a trade, or as a vengeance for injustice suffered. The improving of these is rare. The second class of recidivists comprises those with inborn criminal inclinations. In prison they are inclined to coarseness, boldness, resistance and willful spoiling of their clothes; they may be regarded as in the first stage of insanity. But legally the recidivists are sharply distinguished from the insane. Delusions disorder the judgments of the insane, but not so in the case of the recidivist. Thieves, swindlers and incendiaries, if not insane, are cowards; robbers and murderers are little affected by fear. Between mental health and insanity there are many cases of hereditary anomalies: nervousness, irritability through the least cause, peculiar unconquerable inclinations, eccentricities, propensity to dissolute ideas with no purpose, a mingling of contradictory peculiarities, of one sided mental powers—this all, united with a weakness of deliberation; here belongs also the inborn criminal instinct. According to Richter, most crimes, especially murder, audacious burglary, common theft, embezzlement, resistance of state power, come by epileptics, or in those with a tendency to epilepsy. Those addicted to alcohol are light offenders. Those with hereditary mental weakness are given to crimes of unchastity.

The class of recidivists is a mixed one: (1) Those who have a positive tendency to insanity or epilepsy; (2) Those whose family antecedents plainly lead them to crime; (3) Those whose morality and sense of honor are destroyed through training and environment.

Criminal phenomena and manifestations of insanity are a distorted or diseased expression of mental activities, which by themselves are present in everyone; but in some they develop in one or the other direction. No one is sure that his mental soundness cannot be endangered through outer or inner troubles; or that he can escape inclinations, which might lead to crime. The increase of crime keeps step with that of population, or rather, with its increase in density, as in large cities. The increase of both insanity and criminality is due to over-population.

Indeterminate Sentence and Conditional Liberation. Z. R. BROCKWAY. Proceedings of National Prison Association of United States, for 1887.

One of the best and most successful methods in criminal prophylaxy is at Elmira, N. Y., under the charge of Mr. Z. R. Brockway, a leader and innovator in prison discipline. We give the following to illustrate some points in the method. The true idea of the indeterminate sentence includes all classes of prisoners in custody without any maximum or minimum term. Thus applied, it includes conditional release and the marking system, which are inseparable. The indeterminate sentence

substitutes in the mind of the prisoner, and in the public mind (more important) the idea of correction instead of punishment. But penal treatment is not abolished. Prison discipline is rather intensified. Punishment does not make a man a safe citizen; pain is soon forgotten. When one sees that his conduct is an expression of soul-defect, making him unsafe to his fellow-men, he gets a rational confidence and is likely to get on better than if restrained by fear.

The indeterminate sentence contributes to the idea of certainty as opposed to severity; certainty and celerity of trial, conviction and cure are beneficial both in case of the criminal and the public. Another advantage is in placing the responsibility of determining the date of the prisoner's release upon the warden, who should know his prisoners best. It changes the attitude of keeper to convict; the prisoner desires to convince the warden that he is fit to go out; he tries many crooked ways, but eventually realizes his time is wasted; at this point reformation begins; the prisoner's next step is an honest effort to get out in the way the warden marks out for him. The prisoner is released at the best time, since, having earned his promotion, he is hopeful and encouraged. After his release he is surrounded with the strength of legal liability, beneficial to habitual criminals, and indispensable to criminals by occasion. In a reformatory system, the indeterminate sentence gives the strongest and almost the only true motive that influences one to conduct, cultivate and prepare himself properly for free life. Some of the methods at Elmira Reformatory will illustrate this. The prisoners, on entering, are brought one by one to the warden, who says: "How long have you been in the Tombs, my boy, and who came to see you there?" "Mother." "How did you feel to see your mother come out of a respectable home to see her son a felon?" Generally here, if a man has emotion, he shows it. The men are gathered in a group; the warden says: "Well, how long are you going to stay?" Some snicker and laugh. "You can stay five years; you ten," etc. They do not mind it; one year is as a thousand. "Say your mother is sixty; in twenty years she will be eighty, if she is here. Five years—five Fourth-of-Julys." They sober up; they begin to realize it. "Any man can get out in a year, if he is fit to go. Now, do this little thing, and be very careful not to neglect it; otherwise you get a 'chocolate' (offence), and one chocolate report means, you have lost a month." This process involves a perfect record every month in demeanor, labor and school. A man comes with weak will-power; falls month after month. The warden says, put him in a higher grade; five straight months of the best conduct, which means "rationalistic regeneration." On leaving, a position is found him; the employer knows all about him. The prisoner must correspond with the warden each month, with the certificate of his employer. At the end of six months, if he is all right, he goes scott free. If he breaks his parole, he is brought in again. They all obtain positions. Results: We correspond with all of the 2,000 men we have sent out. For 874 men we have the account for each year. We received 76 in 1880, 9 not reformed; 99 in 1881, 10 not good; 85 in 1882, 9 not good; 109 in 1883, 13 went wrong; 121 in 1884, 19 went wrong; 86 in 1887, 3 went wrong.

When the prisoner is readjusted, reformation in the state sense is accomplished. Scientific reformation is based on physical culture and labor in a way that approaches as near as possible the natural relation of labor outside of prison. The prisoner has what he earns and pays for what he gets, supplemented by a complete course of scholastic education.

Individual System. WARDEN CASSIDY. Proceedings of National Prison Association of the United States, for 1884.

Prison labor and free labor are precisely the same thing. The public

account system is the only one the state has a right to employ. In the contract system everything is for the interest of the contractor. Prisoners should not be transported if they are near their families or relations, who can come to see them, as this is helpful. In the Pennsylvania system there are no hospitals; each man is treated in his own room. We have tried the piece-price plan. It works as far as the prison and prisoners are concerned. When a prisoner leaves us he is not known, so his chance for employment is as good as anyone's. The reconvictions at the Pennsylvania prison are not over 25 per cent. for men discharged from the prison; but is as high as 50 per cent. for men who had been in other prisons.

The individual system is the least expensive in the end. There is less reason for punishments, as the prisoners are alone and easily managed. It does not promote lunacy, as sometimes asserted. There is a persistent opposition to this system in the United States, due to political partizanship. All changes tend towards individualization. First, herding is abandoned, and grading introduced; the further step is separation. No two persons are alike; many who come to prison are no worse than the men in the community where they live. They should not be compelled to associate with people who damage them; who would blackmail them afterwards by means of their knowledge of them.

Prison Punishment. WARDEN BRUSH. Proceedings of Nat. Prison Assoc., 1884-85.

The dark cell tends to brutalize and injure the intellect. Some prisoners care nothing about dark-cell punishment. Handcuffing men and standing them around the cell is the best method. If this does not work, we raise the man off his feet a little, which makes him yield. A man should be told that nobody desires to punish him, but the discipline of the prison must be upheld. The whip takes away the convict's manhood. In whipping, one loses the sympathy of the inmates; you must have them upon your side.

Contribuzioni allo Studio delle anomalie del pterion nel cranio umano, ricerche di anatomia. DRS. F. MARIMO e L. GAMBARA. Archivio per l'Antropologia e la Etnologia. Firenze, 1889.

The anomalous data of the wormian bones of the pterion are found in almost all races, and prevail in the inferior races. As to the greater frequency of these bones in criminals as compared with normal men, Lombroso finds 16 per cent. in normal men, 23 per cent. in criminals, and 18 per cent. in the insane. Out of 114 craniums these authors found 28 with this anomaly (24 per cent.). The wormian bones of the pterion are more frequently united to each other in criminals than in normal men; according to Lombroso, 59 per cent. in criminals, and 68 per cent. in the insane, and 28 per cent. in normal men. These authors find the anomaly in prisoners 71 per cent. The presence of the wormian bones in the pterion is associated with the occipital median fossa; in normal men 4 per cent., in criminals 16 per cent., in savages 26 per cent., in the insane 14 per cent., in monomaniacs 16 per cent., according to Lombroso. The authors find that, in connection with the greater frequency of the pterion bones in criminals, there are other defects or arrests of development, and that this coincidence occurs more frequently in criminals. One thing that gives especial value to these results is, that the authors had access to a number of Italian museums.

Ueber ein Universal-Kraniometer zur Reform des kraniometrischen Methodik. DR. AREL v. TÖRÖK, Professor der Anthropologie, Budapest. Leipzig, 1888. pp. 135.

A universal method for measuring craniums is certainly a desideratum for the criminologist, since the results of one method are often incom-

parable with the results of another. The author says that there is no
craniometrical work which treats in systematic connection the single
problems of craniometry, which are taken up by different authors and
on different occasions. Craniometrical technics is under such suspi-
cion, that the most elementary questions cannot be solved without diffi-
culties. To carry out a unified and systematic analysis from the dif-
ferent standpoints would fail, even if one had all the instruments and
apparatus in use, because the instruments have been constructed for a
special end, and therefore only a special result can be reached. The
purpose of the author is not only to make a systematic investigation
of the problems of craniometry up to the present time, but also to con-
sider a whole series of problems which have hitherto been inaccessible
on account of the craniometrical methods employed. There are those
who allow their national spirit to control their scientific spirit, and those
who treat the ideas of craniologists as naïve. There is no essential dif-
ference between the French and German systems, scientifically con-
sidered; one is as good as the other. The results of study on the
cranium should be brought into more certain connection with the head
of the living man. The German horizontal plane has great practical
value, because it can be employed upon the cranium, and at the same
time upon the head of the living man. The French horizontal plane is
valuable, since, of all horizontal planes, it possesses the greatest stabil-
ity with the plane of the orbital axes. But the assumption of the one
plane does not necessarily exclude the other, as the " Frankfurter Verein-
barung " publicly declares.

Owing to the great complexity in the form of the cranium, and to
the fact that the different racial craniums in many of their morphological
variations can only be distinguished by the value of a differential, it is
evident that the craniometrical characteristic of a racial cranium cannot
be given by means of the single profile-angle and by the carrying out
of the few (30) prescribed linear measurements. The two principal
craniometrical problems are asymmetry and correlation. By making
practical use of both the French and German systems, with the addition
of a few new measurements, a large number of linear and angular
measurements are given.

As the author gives that which is essential to all previous cranio-
metrical methods, the work is valuable for any independent worker.
His practical conclusion is, that one-sided craniometrical eclecticism
must be abandoned, and the universal craniometer employed.

Der Schädel des Raubmörders Schimak. PROF. DR. MORIZ BENEDIKT.
    Medizinische Jahrbucher, v. Heft. Wien, 1888.

The author describes the cranium of a robber who had committed
murder. It has interest, as being a very full description, by means of
an apparatus of precision for measuring craniums, and further, on
account of the individual. It is a small cranium; its development from
behind forward decreases, so that the forehead is the least developed; it
is very asymmetrical; the development of the hemispheres is inferior to
that of the mass-development. From the above facts it follows that
Schimak's cranium is of a high degree of inferiority.

Cervelli di Delinquenti (superficii metopica); *recherche di anatomia.* PROF.
    L. TENCHINI. Parma, 1885. pp. 118.

The writer gives the results of investigations on the frontal convolu-
tions and fissures of 32 brains from the prison of Parma. His conclu-
sions do not accord with those of Benedikt, according to which the
first and second convolutions should be doubled, but are in harmony
with those of Flesh, Giacomini and Rüdinger. Yet cerebral anomalies
are more frequent and varied in criminals than in normal men. The

ascendent frontal convolution appears on the surface better defined in its outlines, and more independent of adjacent convolutions. There are four examples of supernumerary convolutions, but only one offers the characteristic anomaly. The author gives a carefully arranged and detailed table, showing the age, stature, weight, crime, along with the cerebral anatomical peculiarities.

It seems to us that while there is not exact agreement between Tenchini and Benedikt, the results of the former are not a strong argument against a cerebral criminal type, since comparatively so few brains of criminals have been studied.

Anatomische Studien an Verbrecher-Gehirnen, für Anthropologen, Mediciner, Juristen und Psychologen. MORIZ BENEDIKT. Wien, 1879. pp. 151.

That man thinks, feels, wills and acts according to the anatomical foundation and physiological development of his brain was a doctrine of faith among the ancients. Owing to the meagre development of anatomy and physiology, this doctrine remained latent for many generations, until the founding of cranioscopy by Blumenbach, and the impetus which Gaul brought to the study of the brain. In spite of all contradictions in detail, the ancient faith doctrine has been more and more strengthened by the results of modern investigations. It is desirable to inquire if the study of criminals' brains will not strengthen still more this faith.

The want of power to resist criminal acts, and the want of feeling the wrong, together with having a clear knowledge of it at the same time, are the two main psychological characteristics of criminals. This defect in moral feeling and willing can be concealed by a superior psychical organization and ability, latent or through complication with insanity. The following facts show defects in the brains of criminals: a defective development of bridges, and thereby an excessive development of fissures; these are found throughout the whole brain. A priori, this would be expected, because otherwise the tendency to defective acts would have been compensated for by other parts of the brain. Criminals are not analogous to monomaniacs, but their actions follow from their whole psychical organization, and in their special manifestation are the product of social conditions. The details of the following results will probably be found to unite with those in epileptics, insane, and in members of encephalo-pathological families. The physiological-psychological value of single facts is not known.

That an atypical and defective brain can function normally, is out of the question. What we do not know is, why such a brain functions this way and not that; and why, under certain psychological conditions, it functions just in this way. From the detailed examination of 19 criminals' brains, two things are established: 1. A type of the confluence of fissures. 2. That those 19 brains belong to this type.

The chief characteristic of this type is, that if we regard the fissures as rivers, floating bodies can pass into almost all the other fissures; also bridges are wanting, which means the lack of important brain substance. The three important fissures of the outer surface, that is, the central fissure, the third frontal fissure and a portion of the interparietal fissure, show a great tendency to unite with the Sylvian fissure, so that we have not only an anterior and posterior rising branch, but also three other branches. Since the third frontal and interparietal fissures tend further to lengthen upwards towards the superior median border, there frequently arise three central parallel fissures, of which the third frontal one appears pre-central, and the interparietal fissure as post or retrocentral. The last formation does not arise through lengthening, but by a flowing together, and partly of fissures that are scarcely seen in the normal

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brain. In the frontal region, the one or the other frontal fissure is united with this central fissure. In some of the brains the inferior fissure becomes long and deep; this cuts often into the superior part of the anterior central convolution, and participates in the formation of the precentral fissure. Thus we have four frontal convolutions, as is the case in the beasts of prey (cat, fox). It is true that a large number of fissures is a sign of development, where a new typical fissure appears; but around fissures where no new development takes place, and especially where the union of the different typical fissures takes place, a large number of fissures means a defect, through the failure of bridges.

The second type was in embryo. Rüdinger has shown that brachy and dolicocephalic brains manifested their characteristics in the fœtal life. It would be important if comparative brain anatomy could show the prevalence of this second type in the lower races. It may be said that there is no fissure idea in the architecture of the animal's brain that may not be seen in the human brain. Since five races are represented in the brains examined, and the deviations from the normal brain are so similar in each, we may conclude that the brains of criminals show variations from the normal type, and the criminals are an anthropological variety or species, at least of the civilized races. This investigation is on the a priori assumption that the criminal is abnormal, but the abnormity is not a disease but a predisposition to it. After a somewhat detailed criticism of Broca's work, the author comes to the question whether from the atypical relations of the cranium one can make any conclusion as to the atypical form of the brain. In the normal brain and cranium the bregma is 4.5 cm. In front of the fissure of Rolando, and the intersection of the sagittal and lambda sutures in the highest point of the perpendicular fissure. The question is, does this relation exist between the atypical cranium and brain? As yet there is no answer. Yet a parallelism between cranium and brain can be assumed, but not a definite correspondence. The results of this investigation, the author thinks, may call forth objections from the side of ethics. He says: " We will not appeal to the facts of empirical criminal psychology, nor to the premises of the psychology of nature, which support our position. Kant's antinomies place freedom and necessity as justified, and at the same time contradictory; these antinomies, however, are the end and purpose of knowledge, and not its premises. One can hold that psychical freedom is only the expression of the psychical realm, but that all psychical antecedents are the expression of certain natural laws, and so one can swear allegiance to an absolute psychical freedom. Kant freed humanity from metaphysical intolerance, but it did not enter into its inheritance; but this generation is entering into a metaphysical neutrality as regards the question of free will."

In closing, the author emphasizes the fact that to correct the criminal and protect society, the criminal must be studied scientifically; hence there should be in universities and higher courts of justice and in prisons, places for instruction and investigation.

Ueber die Beziehungen der Schädellehre zur Physiologie, Psychiatrie und Ethnologie. DR. RIEGER. Würzburg, 1882.

In describing the different points of view in craniology, the writer says, that ethnology is concerned strictly with morphological craniology, enquiring how far cranial forms can serve as race characteristics. Psychiatry has more complicated questions as to the relation between cranium and brain, and between cranial abnormalities and psychical conditions. Here physiological as well as morphological questions must be touched upon. Ethnology assigns too much importance to the cranium and psychiatry too little. Bordier finds that none of his 35 craniums of

criminals were microcephalic, while Lombroso finds that criminals are microcephalic and brachycephalic. The idea of a criminal type is to be ridiculed, and atavistic idcas are a swindle. The only case in which the coincidence of cranial anomaly and psychical defect is without exception is the higher degree of microcephalia. Craniology is a pure mechanical science. Psychology has as little to do with craniology as with brain cells.

In answer to the author we can say that, as far as our knowledge goes, brain cells are an absolute condition to every act of thinking.

Psychologie naturelle, étude sur les facultés intellectuelles et morales dans leur état normal et dans leurs manifestations anomales chez les aliénés et chez les criminels. PROSPER DESPINE. Paris, 1868, (3 vols.)

This is an epoch-making book in criminal psychology, and though not a late work, is full of valuable information. Vol. 1 takes up normal psychology; Vols. 2 and 3, abnormal psychology.

The author defines psychology as the science of the mental faculties, and of their diverse manifestations; psychology should not depart from the study of nature; all metaphysical questions must be set aside, since they do not come from observation. There are two species of psychical faculties, the intellectual and the moral. The intellectual are perception, memory and reflection. The moral faculties are instinctive. The moral sense is the only one of the instinctive faculties which is not only moved by an egotistical motive, but by the idea of duty and obligation, and this in spite of the pain it causes.

The author believes in freedom of will; when the feeling of duty enters in; but in case of simple desire there is no freedom. Freedom of will, or moral liberty, is the power which decides between the good and the evil after a deliberation made clear by the sentiment of duty. Much emphasis is put upon this point. Criminal psychology is treated somewhat extensively, taking up especially parricides, homicides, infanticides, suicides; incendiaries, thieves, prostitutes; prisons, death penalty and prevention. The author, although a spiritualist or idealist, confines himself to the facts of natural science. Insanity is the involuntary blindness of the mind by the passions, which inspire false ideas; but its essence is the absence of moral opposition, of reason, and of light, clarifying the mind.

Most of the facts, taken from the account of criminal processes in the "Gazette des tribunaux" from 1825 to 1868, lead the author to hold that the great malefactors are deprived of the noble sentiments of humanity, especially of the moral sense, and so are not responsible. This is shown, first, by the absence of moral reprobation before the crime, and second, by absence of remorse after the crime. Perversity, which gives the idea and desire for crime and moral insensibility, including the absence of elevated moral sentiments, are the two conditions necessary to the commission of crime.

On account of the grave moral anomaly of the great criminals, punishments are not suitable; but moral treatment is required. The purposes of this treatment are: to cease to punish cruelly the moral insane or criminals, for it renders them worse; and to ameliorate them as much as possible, that they may not be returned to society unless they are capable of conducting themselves well. It is an honor to humanity that the moral laws are not seriously violated by crime, for these laws are not in the consciousness of criminals. The author concludes his whole work in saying that the psychological ideas set forth do not touch in the least the eternal principles of morality and justice which God has placed in human hearts. According to these principles, individuals deprived of free will should not be punished, but treated morally; individuals, who possess free will, and who at the same time freely commit faults should be punished, in spite of their sincere regret, for these punishments are merited.

The State of Prisons and of Child-Saving Institutions in the Civilized World.
E. C. WINES, D. D. Cambridge, Mass. 1880. pp. 719.

This work is the result of eighteen years of study and observation. It contains a large number of facts that can be trusted, as they are taken either from official communications of various governments, or from specialists. By far the larger portion of the work is given to the history of criminology in all civilized countries, which gives it additional value. As to prevention and repression of crime three problems present themselves: (1) how to educate all children of the state; (2), how to save destitute, harmless, neglected and vicious children from a first fall, and if fallen to rescue them from a criminal career; (3), how to bring adult criminals into a better condition during imprisonment. There are always a number of children, who are not reached by public instruction; their destitution, vagrant life, depraved habits forbid their reception; they are brought up to crime and continually supply criminals. Such children should be reached by the infant nursery, kindergarten, orphan asylum, industrial schools, etc. These institutions should be multiplied and aided by the state. The state should assume the control of children under fourteen, who are without proper guardianship.

Preventive institutions should be for vagrant and deserted children; reformatory institutions for all children declared not responsible by the courts. The bases for reformatory prison discipline are hope and sociability. The first stage of imprisonment should be penal, to show the prisoner that the way of the transgressor is hard. The second stage should have inducements to industry, obedience, shortening of sentence, increased earnings, improved dress and dietary; lifting of restraint, enlargement of privilege, anticipatory of the idea of liberty. Maconochie says, "only in society can man be trained for society." But promiscuous and unchecked intercourse must be prohibited. The wills of prisoner and keeper must be in accord. There must be tests of reformation; the passage from imprisonment to freedom should be gradual; the latter part of the imprisonment should be as near as possible to ordinary life. The indefinite sentence assumes the principle of the diminution of crime by the reformation of the criminal. The definite sentence gives freedom to dangerous persons.

Religion is of prime importance, because most potent in action on heart and life; it calms the restless irritation of vice, which saps the moral forces in criminals with strong impulses. Education affords a substitute for vicious ideas and amusements. The benefits of regular labor are self-evident. The state should aid discharged prisoners in finding employment. Innocent persons suspected and arrested should be paid for their loss. Habitual drunkards should be confined in asylums or reformatories only, and held under mild treatment until there is reasonable assurance of reformation. The general conclusions are: to lessen crime by reforming the prisoner; to prohibit political interference and consequent instability in prison administration, and to train prison officers for their work.

Female Life in Prison, F.W. ROBINSON. London, (4th. edition revised). pp. 384.

The book is a faithful transcript of authentic details, putting into shape the utterances of one who was a prison matron. There are women in prison mourning over petty thefts; and murderesses defiant, cheerful and even light-hearted. It is the humble officers in the prison who know the true character of the prisoners, as they are constantly with them. The directors, governors and chaplains are misled every week in the year. The chief reason for writing this book is to give the true character of the prisoners, as seen by those in constant companionship with them. The details of the whole prison life are brought out, giving an insight into this life as it is.

V.—HEREDITY AND SEX.

JULIUS NELSON, PH. D.

In the previous section (this JOURNAL, III, 97–114) we found that not only did the problem of heredity involve psychic or metaphysical elements, but that a rational explanation of the facts of heredity is possible if such psychic powers are assumed to lie at the foundation of the whole matter. The reactions of living protoplasm to the stimuli of the environment are most easily understood, or at least designated, if we use terms familiar to the student of purely mental phenomena, such as, "association" of ideas, "memory," "education," etc.

Reproductive cells are to be considered as similar to the protozoa, but with a more complicated education, their offspring knowing how to associate themselves into the form of an organism, in which each cell, while inheriting all the knowledge of its parent, finds itself choosing a specific occupation, determined by conditions of which we are as yet ignorant. In this statement possibly lies a harmonization of the Kölliker and the Weismann views. The cytoplasm is undoubtedly differentiated, but it does not follow that the idioplasm is so also, although the training this idioplasm receives becomes more and more special as development proceeds. *Reproduction in its widest sense* is nearly equivalent to nutrition, and consists in the multiplication of idioplasm molecules, that is, the growth of protoplasm, by which ordinary food particles become organized, related, and subservient to the forms of motion peculiar to the specific kind of protoplasm, whatever it may be. *Actual cell reproduction* is a secondary adaptation resulting from the limitations of nutrition, and dependent ultimately upon assimilation. *Ordinary reproduction*, as we know it, is the multiplication of the individual organism, and is a tertiary acquirement. It follows that the problem of heredity in its widest sense involves that of assimilation as its physical side. This use of the term heredity includes all that lies at the basis of biology and psychology.

But so far, the idea of sexuality is not necessarily involved in the theory of heredity, and it must be admitted that a careful study of the evolution of sex in the lower forms of life shows that sex is an acquired characteristic, useful for certain purposes, such, for example, as the securing of variation. The fundamental fact of sex is the uniting of idioplasms, usually accomplished by the fusion of cells produced in two different organisms. These cells are mostly unlike, as is often the case also with the cell-producing individuals; and our idea of sex is attached to this third differentiation. But sometimes both kinds of cells are produced by one individual, which is then hermaphrodite or "bisexual." But there is here no double individuality, the hermaphrodite being as singly an individual as any animal, and properly has no sex whatever.

Students of heredity are familiar with the idea of the character of one sex lying "latent" in, or "transmitted" by, the opposite sex. A little thought will show that this phenomenon is exactly the same as that above noted, when we supposed all the cells of the body to have the same idioplasm, but only special portions of the cell knowledge ever to come to application or development. The idioplasm in each cell of a male of a species does not differ materially from that in the cells of the corresponding female, but is "hermaphroditic," to use an abused and misunderstood term. In a similar way the idioplasm of a nutritive zooid of a hydroid colony is similar to that of a defensive or of a reproductive zooid.

Just as everything in biology may be considered as growing out of assimilation by differentiation of primitive methods and organs for securing nutrition, so everything in psychology has likewise been evolved out of the psychic forces that we may suppose needful to secure

a primitive act of assimilation, all the while remembering that the psychological side of the fact is the deeper or more significant. An elaboration of these two sciences along the lines of natural development as thus indicated remains to be made, and for biology can fairly be said to have begun.

In this introduction we have merely suggested certain general foundations upon which the facts brought out in the following reviews may rest in a related manner. The facts will be treated in the following order: First, the sexual phenomenon among the protozoa and the relation of these to the phenomenon of fertilization are considered, to show that sex is a secondary specialization. We next inquire how such secondary differentiation is brought about and as to our ability to control the production of the sexes. Then follows a consideration of the significance of menstruation, leading us naturally into the larger field of physiological and psychological periodicity. Next we take up the subject of ecstasy and of the perversions of the sexual instinct. Then the field offered by anthropological and social facts is outlined, including mythological phenomena. Finally we conclude with pedagogical, hygienic, and other practical aspects of the question, especially family life.

For a consideration of sex among the unicellular animals, consult the following works: *Significance of Sex*, Nelson, Amer. Naturalist, Jan., Feb., Mar., 1887, (noted in the first section of our review). *La vie psychique des micro-organismes*, Binet (noted in first section). *L'instinct sexuel chez l'homme et chez les animaux*, Tillier (noted below). The general facts are presented by the second and third of these authors; the first presents special facts to prove that "sex" as it is ordinarily understood cannot apply to the cells, but only to the gametaphores or the higher organisms. But the author further shows that the fundamental thing which caused the development of sex is the union of idioplasms of diverse experience, but of similar morphological or hereditary education; and this union, he thinks, is not only illustrated by conjugation of cells, but also by the phenomena of karyokinesis which precedes the division or multiplication of cells. The author does not wish it to be understood that he dogmatically denies the existence of a true "sexual" (in a broad sense of the word) differentiation of protoplasmic gemmules (plastidules), but that the facts, so far as we have them, are explicable on a simpler assumption.

Almost all unicellular organisms that are not parasites, exhibit at times the phenomenon termed *conjugation, i. e.*, two cells melt together to form one, in a manner very different from what happens when one cell eats another. With some of the ciliated infusoria the cells are united only temporarily while a mutual interchange of nuclear material takes place. In all cases a new cell nucleus is formed, consisting of material from two different cells. With the vorticellas the nucleus buds off microspores that become the fertilizing elements of some other macrospore, and then (itself having become a macrospore) is fertilized by a microspore from some other individual which is preferably not in the same colony with itself. Here it looks as if there were two sorts of protoplasm, the ordinary vorticella being hermaphrodite; but in other cases the entire cell splits up into microspores, or into macrospores; and in still other cases there is no difference in size or appearance between the conjugating cells. What happens in the case of vorticella is clearly an adaptation useful to a sessile condition. The difference between a macrospore and a microspore is seen to be mainly in the amount of cytoplasm present; the nuclei in the majority of cases are equal. This difference may be readily accounted for when we reflect that the microspore must be a swimming organism, and must find the

macrospore, largely by chance, in a large volume of water, hence a great number of microspores must be produced.

In the case of the metazoa conjugation is always secured by the fertilization of a macrospore (ovum) by a microspore (spermatozoon). When the former is utilized as a storehouse for nutriment (yolk or deuteroplasm) for the developing embryo, the size (as in the case of the hen's egg) becomes relatively enormous, but the amounts of idioplasm that unite are approximately equal, and represent in each case all the characters of the species, including those that are peculiar to each sex. That conjugation is not an absolutely necessary occurrence is shown by the fact that if it is prevented the egg often develops as if it had occurred, and in many instances parthenogenesis is normal, as in the plant lice; and furthermore, in some of the lowest plants, where the embryo is very simple and does not require the large store of deuteroplasm, even spermatic parthenogenesis occurs, especially in the case of microspores of the algæ.

Thus we are excluded from the hypothesis that there are two sorts of protoplasm, the union of which, is needful for life. But what is the significance of conjugation (or fertilization)? Evidently the idioplasms of the two cells have had different experiences. The chances are that many cells have "gone to the ground" while this experience has been acquired, and that if each cell before conjugation had to encounter the trials the other has surmounted, it might succumb. How easy to unite the two experiences and enlarge the life. "Two heads are wiser than one," is the law even among the protozoa. Hermaphroditism is usual with sessile organisms like mollusks and barancles; and is understood to be an adaptation to a fixed condition, mutual fertilization being advantageous. When the ova are fertilized while yet in the body and the spermatozoa are conveyed to them the production of a smaller number of fertilizing cells is required. A further advance is possible by substituting for a large yolk, the uterine gestation of the embryo. These advances cause the acquirement of special organs that become the external signs of sexual differentiation, both psychological and physiological. To apply the idea of sex to the cells is misleading. Even the human embryo is hermaphrodite (properly non-sexed), and rudiments of the organs of the opposite sex are present in all animals. In cases of monstrosities these rudiments suffer more or less of development as may be seen by consulting "L'hermaphrodisme" by Debierre.

If sex is caused by secondarily acting extraneous forces, it becomes an important inquiry to investigate what such forces are, and how they act. This has been done in the most able manner by the following author.

Die Regulierung des Geschlechtsverhältnisses bei Vermehrung der Menschen, Tiere und Pflanzen. Düsing. Jena, 1884, pp. 364.

There appears to be a fixed ratio between the number of male and female births which in many instances approaches equality. For man this ratio is 106 boys to 100 girls. What circumstances cause this ratio to vary? The reproductive organs are very sensitive to variations in the amount of food, and it is of advantage to a species to accommodate the number of offspring to the supply of food available. The number of offspring depends primarily on the number of females, hence there must exist an association between the tendency to the production of ova and the fact of increased food supply if any regulation of this sort is present. Facts show that such is the case. In general terms the law may be stated thus: good nutrition and moderate exercise of the reproductive organs produces a tendency to the production of females, while poor nutrition and excessive exercise of these organs produces a tendency to the production of males. The eggs of the queen bee receiving

an accession of strength through fertilization develop into females. During development a special feeding of the larva produces a complete female or queen; a poorer feeding produces incomplete females or workers. The development of males only from unfertilized eggs is known as *arrenotoky*. In the more ordinary forms of parthenogenesis exhibited by plant lice the production of males drops out altogether, and unfertilized eggs produce females only, this is known as *thelytoky;* and it arises through the easy conditions of nutrition brought about by a parasitic life. Parasites are remarkably fertile in eggs, and usually, also, parthenogenetic, *i. e.*, reproduce by *agamogenesis*. (Sexual reproduction is termed *gamogenesis*). The male has been termed the "hunger generation," arising either exclusively or in increased numbers when the conditions of life become hard. This may explain the excessive mortality of male infants both before and after delivery. The male embryo is a higher development than the female and requires better conditions, yet paradoxically, is produced under unfavorable conditions. In gamogenesis we have two degrees: favorable conditions producing females and unfavorable ones males; but gamogenesis itself arises under relatively unfavorable conditions, while parthenogenesis on the one hand, or simple cell multiplication (resulting in growth in multicellular animals and asexual reproduction in protozoa) on the other, arises under the most favorable conditions. Thus it results that in animals that multiply exclusively by gamogenesis, as does man, that plethora produces sterility, and the change merely from an animal to a vegetable diet has cured it. The poor have large families. It would be interesting to group the working classes into the "comfortable" and the "very poor," and compare the sexual ratio. It may almost confidently be predicted that the male excess will be greater and the number of children per marriage less with the very poor than with the moderately poor. In a general way increased nutrition tends to increase reproduction at the same time that it favors female births. Temperature affects reproduction by acting on nutrition, less energy for maintaining the body temperature being required in high temperatures. Haycraft has shown that a rise of 1° effects a rise of five per cent. in the births. The yearly curve of the birth rate is highest in summer and lowest in winter, the maximum and minimum points are at the beginning of these seasons (as respects the climate, not astronomical seasons), in June and October respectively. A series of curves for a long succession of years representing the variations in the harvests, the marriages, the births, the living births, the ratio of girls to boys (and inversely of boys to girls) are all parallel. There is always a rise in the male births after a war.

Another phase of the same fact is known as "Thury's law," which is, that *young reproductive cells tend to produce the same sex, and old ones to produce the opposite, e. g.*, if animals are paired so that the male is in the beginning of heat and the female is near the close of heat, the forces from both parents tend towards male offspring. The "Hofaker-Sadler law" is still another phase of this same principle (that delayed conception of the female tends towards male offspring), applied to the relative ages of the parents, as based on statistics of the age of the wife at the time of the first child, compared with the age of the husband, *e. g.*, the wife older than the husband, or relatively old when married, tends to produce male offspring.

Düsing would regroup the statistics and modify the form of the law as follows: Each sex at the time of its highest reproductive vigor tends to produce the opposite; and variations in both directions, either younger or older, are unfavorable to reproductive activity. First-births are excessively boys, due to the relatively higher continence of the female. The strength of crossing, as compared with in-breeding, is favorable to the production of females. This explains why the excess

of boys is greater in the country than in cities. The variety of conditions of life acts in a manner similar to the effects of crossing, while the monotony of country life co-operates with the scarcity of new blood toward the opposite effect. Legitimate children are to a greater extent males than illegitimate ones. This is explained by the fact that marriage tends to obliterate differences between the partners. The very hereditary principle or idioplasm of the female is so profoundly assimilated to that of the male, that the children by a second husband partake of the characteristics of the first, a law well known to stock breeders. This is a fact that no theory of heredity has yet tried to explain.

Here we are tempted into a digression. If the character may be modified by circumstances, so that conditions of life may replace crossing, as when an organism transplanted to new countries multiplies (often asexually) with extreme vigor, may it not be well to investigate what effect associations of the parent may have upon the character of the child. The whole subject of the effect of the life activities of the mother on, not alone the nutrition of the child, but upon its idioplasm, is as legitimate an inquiry as the effect of such conditions on the ovum before or during fertilization. Neither inquiry has as yet been handled with sufficient scientific skill to warrant positive statements. The belief that the imagination of the mother may mark her child in a definite manner, is universally held by unscientific people, or such as are not informed of the results of scientific investigation in this direction; but these experiments (like Galton's experiments to disprove pangenesis) are too meagre, and of simply negative nature. The subject is one so complex, that a renewed investigation with enlarged methods is required. The questions here raised suggest a connection with telepathy or sympathetic psychic response—a subject not yet properly investigated by either friend or foe—as do also the phenomena of sexual attraction.

Returning to Düsing from this digression—the most powerful factors determining sex are those acting on the reproductive cells, but it frequently happens that the algebraic summation of these leaves the ovum so near equilibrium that subsequent forces acting on the embryo determine the sex. Hence the reason of the prolonged hermaphroditism of the embryo, that all the forces may be summated. It is found that twins are generally of the same sex, because of the similarity of the nutritive conditions. *Multiparæ* are a general evidence of vigor, and hence show an excess of girls for twins, but for numbers higher than triplets the nutrition of each embryo is correspondingly limited, and here a great excess of boys occurs. In thelytoky, where the approach of winter causes males to appear, as *e. g.*, in *Cladocera*, the males appear gradually, and some are hermaphrodite. Sometimes insects are found in which different sectors of the body are of different sex. This may be explained by opposing tendencies of the idioplasms of the parents, (one tending toward female, the other toward male production), and an incomplete mixture of the two in fertilization, so that the first plane of segmentation (which has been shown by Rauber to furnish the two ancestors of the cells of the right and left sides of the body respectively), has distributed the two idioplasms unequally. This unequal distribution may be seen even when the sexual tendency is harmonious, whenever the peculiarities of the parents appear separated in different portions of the body. One force cannot be regulative, but the interaction of many forces tending in opposite directions is needful to hold the balance near the position of numerical equality. These forces act upon the race. In a given instance, it would be impossible to predict what the result will be, owing to our ignorance of the value of the forces that have been operating, (just as the table of vital statistics can show how many persons are to die during a fixed period, but cannot

point out the individuals). There are plenty of theorists who have tried to teach how sexes could be produced at will, among which consult,

Die willkürliche Hervorbringung des Geschlechts bei Menschen und Hausthieren. JANKE. Berlin, 1889. pp. 579.

This work is a synopsis of various theories of sex. About 400 pages are introductory to the main thesis, and about 100 pages are devoted to notes supplementary to the introductory matter, which treats of the history of sex and heredity theories from Aristotle down. Then follows an historical section on fertilization and causes of sterility, sections on menstruation, the how, when and where of fertilization, followed by sections on artificial fertilization, stirpicultural and other social developments connected with the relation of the sexes. Further sections on the origin, regulation and differentiation of sex lead to the main thesis, which is, that the mother's influence is represented by male offspring and the father's by female, and *that the more finely nervous organization overcomes the more plethoric and determines the sex.* This is almost the identical conclusion advocated by Starkweather in his work on the *Law of Sex*, in which typical couples are taken and the sex of their offspring predicted. The weakness in this work lies in the method of treating the temperament. So many factors are taken into consideration, that the data presented by any family whatever can easily be made to substantiate the theory; but when we try to apply the theory in special cases, we necessarily meet serious difficulties in the many positive and many negative quantities, each of unknown value, to be considered. Fiquet, Hanssen, Lehndorf, the Talmud, and others agree with the above mentioned authors in believing that sex alternates, and that the stronger of the two factors prevails in the determination; but Düsing has shown that the facts that favor such views are really the outcome of the general laws of sex with reference to nutritive states. If the tendency to alternation could be proved, it would account in a simple manner for the numerical equality of the sexes. A thorough acquaintance with biological facts gives precedence to the principles enumerated by Düsing, and such alternation would itself ultimately rest upon alternations of the nutritive conditions. A census should be taken of the order of the sexes in births, to ascertain if a tendency to alternation exists. Nearly all the facts adduced by the thousand and one theorists in support of various fantastic views are assimilable with the Düsing principles, as for example, the following: artificial fertilization produces males; female slaves produce an excess of females; the longer the pause between births the greater the number of female births; tropical peoples bear more females (this, too, with a desire for males so strong that female infanticide is practiced); the parent of strongest passion (reflex action of vigorous sexual elements) determines the opposite sex. Criminals (who are of strong nature) beget daughters in excess; second marriages produce boys in excess, etc. Some thinkers, like Retzius, affirm sex of the different organs of the body, the endoderm being female, the ectoderm male. Others, like Heincke, go further, and affirm that the right side of the body is male and the left female, so that the union of spermatozoa from the right testicle with ova from the right ovary produces males. Stockton-Hough (*The Laws of the Transmission of Resemblance from Parents to Children*, N. Y. Medical Record, August, 1873) believes in an alternation of the sexes due to the effect of the preceding child in its influence upon the development of the subsequent child. Other authors have held an alternate action of the two sides of the body; but cases of ovariotomy have failed to substantiate their views. Millot and Roth believe that sex is determined by the relative positions of husband and

wife during sleep; the magnetism of the right side of the male, acting on the left side of the female, produces females. But the number of ridiculous theories is nearly endless, and we stop here. Connected with these theories are formulæ for making the children resemble either parent. These have been stated in a most complex manner by Girou, but are too lengthy for presentation. The gist of them lies in his view that the internal organization is most often transmitted to the same sex, the external to the opposite, and heredity plays a great rôle; if a father resembles his mother, his daughter will resemble him, etc. This subject, like the rest, has received a good deal of attention from theorists, but the entire matter is confused and contradictory, both with facts and with itself in any one author, and becomes chaotic when different writers are compared. This part of the subject awaits scientific investigation.

On the physiology of menstruation, consult, besides Janke,

Physiologie der Zeugung. GRÜNHAGEN. Leipzig, 1883.

This author presents in a condensed form what is known through various investigations upon the subject of ovo- and spermatogenesis, menstruation, methods of reproduction, etc., etc. Concerning the simpler phenomena of ovogenesis, there is considerable agreement, but hundreds of investigations have been directed toward the solution of certain problems connected with spermatogenesis. We may roughly recognize the following schools: (1) Those who, like Biondi, believe that only one sort of cells exists in the testicular epithelial layer, and that the large cells near the wall of the follicle bud off nuclear bodies, each of which, by karyokinetic division, finally produces a group of cells from which the spermatozoa arise by direct metamorphosis. These cells or *spermatoblasts* are arranged in a column whose base embraces the perennial mother-cell. (2) Those who think the basal cell is the female part of the original germ-cell, and will be thrown off. (3) Those who think the basal cell is a distinct kind of cell with which the spermatozoa produced outside it have secondarily conjugated for nutritive purposes. (4) Those who believe these cells are only supporting elements, furnishing a sort of spongy net within the meshes of which the spermatozoa are held until discharged. It is the first two schools whose difference is of radical interest, though it may be mentioned that Balbiani thinks the "yolk nucleus" sometimes seen in eggs represents an epithelial (male) cell from the mother which has fertilized the egg, and that a similar fertilization of female protoplasm from the father takes place in spermatogenesis. But we pass on to the main subject, and refer mainly to Tillier's work.[1] In animals there are definite seasons when the reproductive activities are at their height, the physiological state being known as "heat" or "rut." This period has been established in connection with nutrition and climatic conditions favorable to the rearing of the young. These periods usually occur at the same time in the two sexes. Both undergo the profoundest physiological and psychological changes, everything seeming to subserve reproduction. (On many of these points, cf. Darwin). When we turn to man, do we find anything comparable? At the period of puberty, the human youth of both sexes develop special characters that have a reproductive significance, but these characteristics are practically permanent. In the female, however, there is a monthly rhythm supposed to be comparable to that in animals. The medical dictum now is that menstruation is ovulation, or marks the successive completions of maturations of ova and the bursting of a Graafian follicle, setting free the ovum. The ovum is received by the Fallopian tubes and carried to the uterus by the action of cilia. Meanwhile the spermatozoa, if present, swim actively against the ciliary

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[1] For title see below.

current, and meet the egg either at the surface of the ovaries or in the tube, or at times only in the uterus. The point of meeting determines the relative ages of the two elements, and is supposed to be of significance in determining the sex of the product. The egg, when fertilized, is an independent being that becomes parasitic upon the uterine walls, causing the neighboring cells to proliferate and grow around it, and successively to develop the placenta. This effect of the egg upon the tissues is exerted upon other organs, as seen in abdominal pregnancy, and is in itself a very remarkable phenomenon, which can be understood only when the general principles of parasitism as exhibited throughout nature are understood. Fertilization has other effects, such as may be felt by the mother, but its first evident effect is the suppression of the menses. How is this accomplished? Menstruation is the periodic congestion of the uterus and ovaries, succeeding a gradual hypertrophy of the uterine walls and ending by a sloughing away of the extra growth. What is the significance of this? Theory alone gives its uncertain answer to both questions. We know but few facts in addition to the above enumerated ones. We know that conceptions are most frequent just immediately succeeding the flow. Pflüger thinks the old mucosa has been taken away to prepare a fresh surface for the attachment of the egg. But cases of conception at any portion of the period are known, and if such occur just before a flow, the flow is still suppressed. Lowenthal's view is that the length of the period is fixed by the length of time an egg may remain unimpregnated in the uterus before it dies. The egg, on this theory, is supposed to fixate itself before fertilization and to cause the mucosa proliferation (just as if fertilized), but when fertilization is delayed until the egg dies, an abortion takes place which is menstruation. Then the uterine congestion affecting the ovaries causes a new follicle to burst, and the experiment is repeated. Similarly Flesch holds menstruation to be a washing away of an egg too old for fertilization. Cases are known of menstruation continuing after complete removal of both ovaries, which fact seems fatal to this ingenious theory. To be sure, the menses, like other sexual characters, have become established because of the presence and development of the ovaries. (See PALLEN, "*Philosophy of Menstruation, Conception and Sterility*," in Dr. Serguis's series of American Clinical Lectures, Vol. III, No. 3, N. Y., 1877). Once established, there seems to be a sort of independence in the activity of both organs which usually coincide in their periods; such is the view of Beigel and Reinstadter, but Foekkistow thinks the fact that ripe follicles have been found in the intermenstrual period, shows that ovulation is not periodical but continuous. Carpenter advocates the view that the egg does not reach the uterus to be fertilized until a week or more after the cessation of the flow, and hence the Levitical prohibition of coitus until after this time. On the other hand, Loewenhardt thinks the egg leaves the follicle before menstruation; and the independence of ovulation from menstruation is shown, according to Winckel, by the occurrence of ripe follicles in females who have never menstruated. Sappey has shown that at three years of age the ovaries are furnished with their complete stock of eggs (nearly a million), and Morgagni relates a case of a babe four months old which menstruated. Cases of continuous menstruation as well as continuous lactation are known. Nursing usually stops menstruation, and if excessive, may cause atrophy of the ovaries; or if suddenly stopped, causes ovarian inflammation. The reflex connection of the breasts and reproductive organs is also testified in other ways. Excessive continence, as well as excessive venery, causes a cessation of the menses, accompanied by sterility. Fertility is related to the vigor of menstruation, but not in an absolute manner. Conceptions of non-menstruating women are known, but cessation of menses, of fertility and of ovulation occur

simultaneously at the change of life (See Tilt in first section). This is about the extent of our knowledge, but no theory has satisfactorily combined these facts into a harmonious whole. Cases of male menstruation are known; the reviewer has given reason for believing in the presence of a monthly rhythm that affects all the psychic as well as biological activities of both sexes. (*A Study of Dreams.* This JOURNAL, vol. i, 1888. pp. 387 *et seq.*).

Let us look a little further into the subject of periodicity, which is so closely related to or dependent upon the presence of the reproductive organs. First consult:

Periodische Psychosen. KIRN. Stuttgart, 1875.

Esquirol has formulated the laws of periodicity in disease : disease may be 1st, intermittent due to the cylic development of parasites; or 2nd, due to definitely recurring causes, or 3rd, as related with menstrual periods, or 4th, due to other diseases themselves due to periodic conditions, and 5th, due to no assignable cause. The length of the periods may be very variable from hours to days or weeks or months or even years. The length of the relation of the depressed, the normal and the exalted portions of the periods of cyclical insanity may be various and may change progressively during the run of the affection. Certain general observations may be made. Periodic diseases, (mental diseases, or those in which psychic symptoms are very prominent, form the largest class of periodic diseases), develop usually during the adolescent stage of human development and are common again at the climacteric; more than half of the cases are accompanied by sexual exaltation or by a desire for stimulants. Cases often show an alternation of melancholy and mania separated by clear intervals. Such cases are graphically represented by a curve rising and falling successively through a normal level. A typical case of cyclic or circular psychosis presented a normal interval of some months followed by melancholy that turned to mania with a couple of days clear interval separating the two states, at the same time the sense of double personality was intense in both conditions of abnormality. The periods themselves may be grouped; several fall close together and then follows a long free interval succeeded by another group of waves. Small waves may be found superimposed upon the larger ones. Finally cases are considered in which each wave begins with either exaltation or depression and ends with the same phase, the opposite condition forming the middle of the wave. These cases are united with disease of the reproductive organs and occur in connection with the menstrual period. Krafft-Ebing refers the sexual trouble to a neurosis; but Kirn reminds us that this neurosis was stimulated by the periodic ovulation causing a wave of cerebral hyperæmia. One case showed that the brain congestion was due to a periodic swelling of the thyroid, pressing the jugular veins.

Ein Beitrag zur Lehre vom menstrualen Irresein. BARTEL. Inaug. Dissert. Berlin, 1887.

After noting that one-third of the cases of female insanity are traceable to menstrual disturbances this author classifies cases of periodic disease into those whose period coincides with the menstrual month, and those that do not. The first-class has two sub-divisions, those truly insane and those nervously disturbed without real mental alienation. The brochure is in the main a detailed study of a single case.

An able handling of the subject is seen in the next work.

Ueber die Gesetze des periodischen Irreseins. KOSTER. Bonn, 1882.

The moon is from 47 to 55 thousand miles nearer the earth in perigee than in apogee and exerts a correspondingly greater effect ($\frac{1}{6}$) upon

the state of the earth (magnetic and gravitational). The time of completing a revolution about the earth is called an *anomalistic period* and varies from 25 to 29 days, average 27½ days. The moon's phases form the *synodic period* of a little more than 29 days. (The anomalistic period is the same as that called a physiological month, of four weeks or 28 days, by the reviewer, in the article on dreams noted above.) Koster takes the week of 7 days as the anomalistic number and using it as a divisor ascertained the fact that nearly all periods observed in periodic diseases, no matter of what length, are compounded of various multiples of this number of days. It is unfortunate that the number is so small, because a variation of only three days is sufficient to nullify the generalization. The reviewer has hinted in the article on dreams that the periods may vary, being shortened and lengthened by different causes; this swing of a monthly period may be as great as seven days, *i. e.*, menstruation in place of coming on the 28th day may be delayed as much as a week. Such variations are probably present in the majority of cases cited by Koster and explain the following statistics. Out of 942 waves recorded, 129 coincide with the anomalistic period, 335 fall one day out of the way (exacerbations beginning at night often recorded next day) ; 306 fall two days out and 172 fall three days out. An inspection of Koster's tables shows that in the main the anomalistic law governs, but from the nature of the case the method of summation presented in the statistics as just recorded, is hardly a fair showing for the theory and does not weigh much in favor of the real facts. Koster has failed to realize that these periods are not related to the astronomical facts as the tides are, but are independent associations obscured by many secondary reactions of living matter. Darwin has sought to account for the menstrual period by the effect of the tides upon our distant aquatic ancestors, but there is no need of going so far away. The effect of the moon's phases and also of sabbatical observance acting through the mind upon the body, or else as favoring certain sexual activities is sufficient in itself to account for the existence of the period. That meteorological conditions act on the body is not denied, but they are in no sense to be taken as producing inevitable effects. Association can over rule a purely physical effect upon the body. There are marked diurnal waves of fever exacerbation and of the temperature in normal cases as from 7-10 A. M. and 3-6 P. M., but here also are great individual variations. The time of perigee or apogee is recognized as peculiarly critical especially in mental diseases. Dr. Solviette has called attention (from seven years observation) to the parallel variations of the earth's magnetism and of psychic disturbance. The spirits of some people rise and fall with the state of the barometer and it is said that bees indicate a coming storm even more certainly than that instrument. Suicides are most frequent near the summer solstice, (compare the curve indicating the reproductive activities). Observations of the same data are needed for the southern hemisphere to show whether this is an effect of heat or of the relative distance of the sun, but we may venture to prophesy that the position of the sun will be found of no importance except as it affects temperature. The eleven year periodicity of the sun spots is known to affect the earth's magnetism and its climate. A study of the movements of civilization is needed to ascertain to what extent this period is represented in biology. Another period is presented by the alternation of quadrature and syzygy of sun and moon with our planet. Here is a field for considerable statistical study.

At this point we may conveniently consider :

Zusammenhang der Geschlechtskrankheiten mit nervösen Leiden und die Castration bei Neurosen. HEGAR. Stuttgart, 1885.

Castration does not always eradicate sexual feelings. Neuroses that begin with puberty are related to the periods in some definite way

either occurring during menstruation or in the interval or else during pregnancy only, and are dependent upon the sympathy between all the organs of the body as excited by the pathological changes occurring in the reproductive organs. Pressure upon the ovaries can produce or can stop convulsions. Here we may refer the reader to certain aspects of hypnotism and the so called "hypnogenic zones." Dr. McKenzie has shown that nasal disease is dependent on genital irritation. The deductions are plain, viz.: that the reproductive organs are in nervous connection with various parts of the body, and hypnotism which has received much light from comparison with the phenomena of normal sleep, ought also to be viewed from the sexual standpoint. The school of hypnotists (Nancy) that interprets the phenomena as forms of true sleep, also state that men are as susceptible as women. The belief of the mesmerists that women are the more susceptible may in part be explained by their methods, which in many instances lead to scandal. In this connection we may naturally consider the subject of ecstacy.

Ekstasen des Menschen. MANTEGAZZA. Jena, 1888, pp. 461.

Ecstasy is defined as a worship, a giving up of the will to the dominance of an emotion; but that emotion should be of an elevating sort. Examples are: the different sorts of love and friendship, patriotism, self-sacrifice, religious vision, contemplation and prayer; esthetic raptures in relation to music, color, symmetry, etc; the intellectual ecstasies, as displayed in eloquence, action, pursuit of truth, science or philosophy, and in mental creation. The ecstasies of animals are connected with sexual reproduction; the love songs and love bowers may also be referred to. Among children is found the ecstasy of play and motion which may be termed "muscle drunkenness." Home sickness, joy, love of solitude or of society are brought under the categories of ecstasies. Friendship is a "Luxusgefühl." Love is a necessity growing out of the union of parts needful to form a complete man. The soul is sexed as well as the body, and soul union may be felt in which the slightest bodily contact (even a kiss) would be felt to be earthly. The work is poetic and beautiful as a literary production, but hardly as valuable as his anthropological studies. The same author's "Hygiene der Liebe" and "Physiologie der Liebe" are not the equals of the "Ekstasen," neither from a scientific nor from a literary standpoint. The effects of ecstasy when excessive are injurious to health. Among abnormal ecstasies is to be classed that artificially produced, which in its lowest phases is presented as alcoholism, morphinism, etc.

These phenomena have important bearings on many of the problems of sex which we cannot now stop to point out. The craving for stimulants has very evident analogies with the impulses accompanying perversions of the sexual instinct, of which a word:

As in its normal development love between the sexes is the most charming and universally attractive of human emotions, so in its perversions it is the most disgusting and repellant. The abnormalities have received a certain amount of attention from alienists, but the amount of information as to normal action which the study of these states can yet furnish is insufficient to justify a detailed consideration of them here. Those desiring to pursue the subject further may be referred to the following:

De l'inversion de l'instinct sexuel. CHEVALIER. Paris, 1885.

Die krankhaften Erscheinungen des Geschlechtssinnes. TARNOWSKI. Berlin, 1886.

Physiologie de l'amour. GLEY.

Le fétichisme dans l'amour. BINET. In his Études psychologie expérimentale. Paris, 1888.

Psychopathia sexualis. KRAFFT-EBING. Stuttgart, 1887.

The chief points of interest to psychology may be very briefly summarized. These pathological cases show that the emotion normally felt toward an individual of opposite sex may suffer change in its whole character, or may be transferred (together with the feeling of shame and the whole complex of associated feelings) to an individual of the same sex, to a lower animal or even to inanimate objects, including corpses, and be felt with reference to such things alone. Cases of all degrees between the normal and these remarkable extremes are found. In many cases it seems as if sufficient knowledge at the start might have prevented their development. These conditions arise through anatomical lesions or defects, through disease (especially disease or breaking down of the central nervous system), by congenital tendency and by direct acquirement. Some have speculated that the mind is sexed and may be of opposite sex from the body. Others look to the principle of atavism, similar things being wide spread in the customs of lower races, and having had parallel even among the more cultured people of antiquity. The efforts of the mediæval church for the eradication of lust by the separation of the sexes in convents and monasteries frequently resulted only in its transformation. The work of Krafft-Ebing is at present the most complete upon the subject, bringing in the anthropological as well as the pathological aspects of the question. Binet finds a latent possibility of these perversions in normal people, in that they tend to give exaggerated importance to subordinate matters, which in his term is "fetishism." .Cases of perversion are rare with savages, and, he believes, occur chiefly with those persons who allow imagination to replace a sensation by an image, a process allied to the tendency to abstraction. We now turn to a consideration of the anthropological side of the subject.

L'instinct sexuel chez l'homme et chez les animaux. TILLIER. Paris, 1889. pp. 300.

The author introduces the subject with this thought:

The organs of the body have reference to two great ends, one the preservation of the individual, the other the preservation of the species. The latter is the more important function, the former being subordinated to this end. Then follow chapters on the origin of sex, fertilization, the reproductive instinct, the sexual instinct, etc., etc., most of which we have incorporated in its proper place. He considers that Darwin has stretched a point in supposing the females exercised a choice of the males, the acts of "courtship" tending rather to excite passion. Perversion of sexual instinct are often seen among animals. The subject of animal marriage concludes the zoological portion of the book. Both polygamous and monogamic families exist among the animals, and each sort may present social or solitary methods of life. The necessity for rearing the young, in order that the species might be properly maintained, required the development of those psychic powers, that unite the members of the family, and the members of the troop. How wonderful the psychic powers of such colonies as the bees and ants are is well known. In apes the physiology and psychology of sex closely resemble those of man. The basis of sex love among men is reproduction, and among savages exists as such and nothing more. The successful fertilization of the ovum by artificial methods shows that the psychic accompaniments are not biologically necessary, but are the activities of a developed psychic organism. The following elements have been important in developing present conditions: (1),the standard of beauty leading to ornamentation and pomadization; (2), the sense of shame in connection with the public gaze—the result of education, as witness the innocence of children; (3), the authority of parents and parents-in-law; (4), the necessity of rearing the offspring, at first

entirely left to the mother and in some cases developing a communistic relation among the members of a tribe (Andaman Islanders); (5), jealousy, leading to the appropriation of the weaker sex exclusively by the stronger males causing the punishment of adultery; unappropriated females still remained common property, (primitive prostitution). With respect to the procuring of the wife—she is at first taken prisoner in war and like other booty distributed in the division of the spoils. As such she is a slave simply. In case friendly relations exist between tribes the wife may be secured by purchase. (Curiously enough in some places a mock battle often constitutes the wedding ceremony as a reminder of an ancient method.) The law of supply and demand now rules, and if wives are much desired they bring a corresponding price to the father fortunate in a large family of girls; the reverse conditions gave rise to the dowry. The following work, though more special, treats of the evolution of love among men and animals and may be inserted here.

Romantic Love and Personal Beauty. FINCK. London, 1887. pp. 560.

The main thesis is that beauty in the offspring is dependent upon the development and free sway of romantic love. By romantic love is meant the love treated of by poets, the impulsive play of the emotional nature. This love is a modern development according to Finck; and in the main he is right; it is the evolution of the esthetic nature of man as seen also in the development of music. But this position should not be held in too strict a sense. The same love undoubtedly beat in the heart of Jacob, when he toiled fourteen years for Rachel, although he may not have composed poems or manifested other extravagancies of modern love, which are in a great measure due to an over excitable nervous system. The great majority of successful marriages are probably not preceded by the extreme manifestations of romantic love, but by those more quiet bonds of friendship that join hands with reason and sense, and which are older than history. Beauty which is an index of health is dependent on the free play of those psychic forces that impel to reproduction, universally operative, manifested even down to the protozoa. It is the restraint of these forces by scheming parents who make marriage a pecuniary speculation that unites natures more or less sterile with each other; or that, if fertile, produce second rate offspring. This work is evidently written for the people. A spirit of levity, however, detracts from its dignity, and its facts are culled from various authorities and are not always handled with scientific acumen.

Anthropologisch-kulturhistorische Studien der Geschlechtsverhältnisse des Menschen. MANTEGAZZA. Jena, 1886, pp. 380. Translated from the Italian.

The author has travelled extensively and, together with collections from other authors, presents his observations in a most clear and fascinating manner; the work is undoubtedly the best that has appeared from his pen, and it deserves an English dress. The first chapter of the seventeen is devoted to a description of the rites with which savage people celebrate the establishment of puberty. In all the anthropological relations, the Australians hold the most important position; their highest development being on a level with the lowest seen in other races; and at the same time their various tribes present all the links of the different stages of development, from the most primitive and purely animal stage upward. The Malays and negroes come next in order, the American aborigines and the Turanians next, and then we begin with the Hindoos and travel westward with the tidal waves of Caucasian civilization. The ceremonies of the puberty-declaration constitute, with the Australians, a sort of an initiation, secretly conducted (the

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women being never allowed near), of the youth to membership in the tribe, who henceforth has the privilege of being a warrior and of stealing a wife. The ceremonies consist in the removal of the hair or beard with a sharp stone and often some teeth are knocked out, and other mutilations (sometimes crippling) are suffered. When the girls of Victoria attain an age of twelve years they undergo a somewhat less Spartan trial, but like their brothers are more or less besmeared with filth, the removal of which constitutes the closing ceremony. Similar rites have been observed among the Indians of California. The sense of shame is very feebly developed and while dress is sometimes worn it is only for purposes of protection; yet in some tribes the women use dress for purposes of concealment. In higher races the law holds that the female is more modest than the male. This sense of shame extends even to the face with Mohammedan women. The Japanese are said to be without shame and yet are clothed to an extreme extent. Strange co-existence of the sense of shame with reference to certain relations and not with others of like nature are found nearly universally. Among some peoples continence and virginity are considered as vices, while with others there are laws by which those losing their virginity (females always) are put to death if they desire to become married. Among semi-civilized, and sometimes among barbarous people, laws limiting the times and seasons for exercising the reproductive functions have been enacted and enforced with great stringency. The death penalty was inflicted for the violation of the Levitical ordinances in this regard. Times of prohibition include the periods of menstruation, pregnancy and lactation. A variety of mutilations from circumcision to castration have at one time and another been practiced. It is supposed that these practices were for the sake of political separation, to make a peculiar people; they seem to have been undertaken from religious motives, although some writers suppose circumcision to have a hygienic significance. The origin of the rite of circumcision seems lost in antiquity. The Egyptians, who circumcised soldiers and priests only, may have received it from Abraham. But some South American Indian tribes, many of the Polynesian tribes, the Caffres and some of the African tribes, and the Australians near the bay of Carpentaria practice it in various ways. Among the savage peoples, it is purely a puberty-rite conducted by priests with great secrecy. In its development to the Jewish form the novitiate has been operated upon at an earlier and earlier period. Stages of this precession are preserved with various tribes. According to Waitz many African tribes practice also clitoridektomy.

Circumcision is considered a hygienic measure by Jaffe (*Ritualle der Circumcision*, Leipzig, 1886). But hygienic considerations do not explain the operation as performed upon the females, and we know that other mutilations accompany the practice with the lowest tribes; and constitute pretty nearly the whole of what may be called religious ceremonial of such tribes. Cases in which castration has been performed as a religious rite fall into two classes, those in savage tribes, in which it is important to keep the birth rate as low as possible and those where it is practiced as an antidote to lust. It is very general to require continence of the priest and this has been secured through means both psychical and physical. The Scopts of Russia afford a remarkable instance of all the members of a sect receiving this sign of their regeneration. Nevertheless among these persons passion is not eradicated. The assimilative forces assume a preponderance, as represented in the increase of adipose tissue in the body and the acquirement of wealth in the society.

A very interesting chapter is the one which treats of the customs connected with the wedding ceremony. Mantegazza considers them survivals of the primitive mode of obtaining a wife, viz., by capture, as various

features of the modern dance may be referred to a primitive erotic dance. There are certain social laws whose object is to secure cross fertilization, and which have undoubtedly been evolved in a manner analogous to that of the morphological and physiological characters in the lower animals that serve the same purpose. The passions, even of esthetic love, are strong in the bosoms of several negro tribes. Among certain Australians (and somewhat similarly with some North American Indians) all the members of a tribe are known as brothers and sisters, and are forbidden to intermarry; the result is *exogamy*, either by capture or by purchase. On the other hand, in Egypt, Persia and Peru the marriage of brothers and sisters was allowed. It is remarkable to what extent very different forms (sometimes in one and the same tribe) of various social customs coexist among primitive peoples. The children may be betrothed by parents while infants, yet after they are grown up great freedom of choice is allowed. Even after marriage the husband may grant a divorce if he finds his wife loves another. The position of the wife varies greatly; she may be used (like cattle) as money and be a slave simply, or may have the power to nullify the business transactions of her husband, or sit with him in legislative councils. Polygamy may be practiced only by the rich, who can support so many wives, or may be a means of enriching the husband where they do his work. On the other hand, in Thibet a woman marries a whole family of brothers on the theory that one man is unable to care for one woman. It has been supposed that primitive man was without marriage, and the children were reared by the mother, who was the matriarch; and naturally the custom of polyandry arose in one direction and polygamy in another. Mantegazza ridicules the "promiscuity theory," and thinks the facts with regard to the sexual relations among the lower animals are conclusive against any such view. The facts are that among savages monogamy is the rule. Marriage is everywhere recognized as an institution for the proper rearing of children, and has no other significance; but outside of wedlock a great deal of promiscuity is allowed, without any sense of shame thence arising. As soon as a woman is a wife, she is expected to be and is absolutely true to her husband. The limitation of intercourse with one who is thus actually set apart for breeding purposes (being returned to her parents if sterile and paid for only if fertile) have caused the various legal privileges of the possession of secondary wives or concubines as a restriction upon promiscuity. But a limited promiscuity still existed, as for example, in hieratic prostitution. In esthetic Greece prostitution developed into the second or epicurean stage, with many gradations of this relation. Then came Christianity and a struggle between sense and spirit which is as if only just beginning, and prostitution entered on its third stage—that of sufferance or license. But society at large has still all the tendencies of the savage, barbarous and cultivated peoples of the past.

The following work is standard on sexual anthropology:

L'Evolution du Marriage et de la Famille. LETOURNEAU. Paris, 1888. pp. 467.

This work begins with the animals, traces the love and reproductive relations systematically, and concludes that love is the same in men and in animals. Some birds die of sorrow if their consorts die. The chimpanzee is sometimes monogamous and sometimes polygamous; the old male who is despot of a clan, is finally routed and killed by the young males. The author agrees with Mantegazza in denying the existence of a primitive universal promiscuity, but does not believe in the existence of real love among savages. Among the ancient Mexicans four degrees of marriage existed: (1) monogamic marriage, the offspring declared legitimate; (2) semi-legitimate marriage, (3) legitimate concubinage, (4)

free love or prostitution. In Rome three sorts of sexual relations were recognized : *usus*, cohabitation without ceremony ; *coemptus*, by purchase and ownership ; and *conparreatio*, full marriage, solemnized by religious ceremony. The following are the stages in the evolution of divorce : (1) wife displaced or killed, (2) repudiated, (3) divorced with limitations, (4) for certain reasons only and with limitations, (5) by her consent as well as that of the husband. The natives of Borneo live in herds, and the strongest male drives out the rest, who are thus compelled to capture wives from elsewhere, and start clans of their own. There is no real family ; both matriarchal and patriarchal forms of the family seem to be incipient in this stage. A curious form both of polygamy and polyandry exists in those tribes where all the women are the wives of each male, and all the men the husbands of each woman—a sort of communism. There must have been a long struggle between the maternal and paternal filiation, in which the weaker sex finally succumbed, as the individual, in contradistinction to the clan, became prominent. In later times the personality of woman has been gaining power, as shown by the increase in the divorces. In France these doubled in thirty years, and in Belgium quadrupled. This is held as pointing to the evolution of free love—a conclusion perhaps not shared in by other specialists of equal note.

The evidence for the opinion that primitive religion had a sexual basis is more especially treated in the two following works :

Primitive Symbolism. WESTROPP. London, 1885.

In mythology there is a universal attribution of sex to all things of nature. The sky is father, the earth mother. The sun is the generator ; time, fire, intellect and mind are male ; matter, water and lust are female ; at the beginning of all things stands the eternal asexual One who differentiates into male and female ; these assume the relation of husband and wife, and thus become the creators of all things, which in turn retain the sexual nature. Some of the offspring rebel against the authority of the original Will and, being expelled from the hierarchy, wage eternal war against him and seek to ensnare mankind. To oppose this power of darkness, incarnations of the divine were made at different periods, known in India as *avatars*. Sometimes the male, sometimes the female power is given precedence, and the ancient wars are supposed to represent struggles between devotees of one or the other principle. As symbols of these powers, rude representations of the reproductive organs were chosen, and, after being consecrated, could be worshipped in the visible form. Hence the origin of idolatry. The horizontal line, the inverted delta, an oval or circle, a boat, box or ark, ponds, caves, enclosures, flat-roofed houses and temples symbolize the female ; a vertical line, a rod, a pillar, a pyramid, an obelisk symbolize the male. The union of these symbols, sometimes with one or the other the more prominent, symbolized the generator or the act of generation, and represented the complete factors of worship. Such symbols are the Greek and Latin crosses, the temple with its columns, towers or steeples. At first the pillars were not erected as a necessary part of the structure, but stood by themselves. The symbols often appear in images and ornamentations. Primitive peoples had serious religious ceremonials that degenerated into mere obscenities in the festivals of the more luxuriant stages of their history.

A more thorough discussion of these facts is made by the following author :

Phallicism, celestial and terrestrial, heathen and Christian ; its Connection with the Rosicrucians and the Gnostics, and its foundation in Buddhism, with an essay on mystic anatomy. JENNINGS. London, 1886. pp. 298.

"Religion is to be found alone with its justification and explanation

in the relations between the sexes," says Jennings; in substantiation of which thesis he traces with great detail the phallic element from ancient religions down to its most unsuspected modern survivals. The Hebrew prophets struggled to free the Israelites from the dominion of the sexual worships in the external form. The Levitical law is minute in its regulations of such relations, and Christianity began in a most evident manner (as note the First Epistle of Paul to the Romans) as a deeper struggle against lust, and hence we must approve of Jenning's definition, with which he opens his book. The key to mythology also lies here, but this subject presents so many transcendental and mystical features that a modern scientist is incapable of understanding them, and still less of sympathizing with that action of the imagination, common with ancient peoples, which gave rise to the mythologies. There is one modern writer, however, whose method of dealing with facts is similar to this action, but who, in addition had a scientific training by which he attempted to organize this method into a science, viz., the "Science of Correspondences." We refer to

The Delights of Wisdom pertaining to Conjugial Love and the Pleasures of Insanity pertaining to Scortatory Love. SWEDENBORG. New York, 1885; translated from the author's Latin edition of 1768, pp. 472.

This is the most readable of Swedenborg's Theological Works, the characteristics of all of which are a heavy minute style, ungarnished with figures, although the author claims to hold the key that unlocks the meanings of all figurative and symbolic expressions. He deals with conceptions beside which those of the Divina Comedia are limited. The chapters are interspersed with " relations " that are records of his visions and serve to illustrate or confirm the philosophical parts. Everything seen in the Spiritual World has the same ponderous character. The speakers in dialogue are always talking Swedenborgianism. This peculiarity alone, is sufficient to demonstrate that his " spiritual world " was a subjective state, and justifies our calling his " visions " hallucinations. The " opening of his spiritual sight " seems to have followed in consequence of a severe struggle with his lusts, which he finally succeeded in completely subduing. (See pp. 173-197, Worcester's " *Life and Mission of Emanuel Swedenborg.*" Boston, 1883). According to Swedenborg, the oneness of the Creator, results from the conjunction of two principles, Wisdom or Truth and Love or Goodness. From this union results a perpetual " proceeding" or activity, the Life of the Universe; and created things are necessarily dual in nature (of form and substance) corresponding to this original bisexual Creator, who is represented in material form by the Sun, from which in conjunction flow Light and Heat, in correspondence with the Wisdom and Love. This is not a mere analogy created by man's fancy, but the actual appearance (on the plane of physical sensation) of forces that in reality exist only as the conjunction of Wisdom and Love in the Spiritual Universe. Consequently all physical things have their spiritual counterparts, and the obliteration of the spiritual would cause a cessation of the existence of the physical. Sex is in all things and is derived. If the soul were not sexed neither would the body be sexed[1]. True marriage is therefore not changed by death. By Conjugial Love is meant the primary spiritual attraction between persons of opposite sex. Each person and thing is such through the union of masculine and feminine forces; but this new unity is either masculine or feminine, relative to a union of which it becomes a factor. The Lord himself is male over against the female Church, bound to him by " love truly conjugial." The inversion of love causes repulsion. Hence the origin of Hell, which necessarily has

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[1] Swedenborg makes a radical distinction between *conjugal* and *conjugial*.

just as many organs and regions as the church or Heaven, because formed of individuals in all parts of the Grand Man, (that higher social complex in which each person is a gemmule). The inversion of conjugial love is caused by the ascendency of the love of self, as noted in our review of the Rational Psychology. Equilibrium and spiritual freedom result from the fact of man's self-consciousness arising in the rational mind between the spiritual mind on the one side and the animal mind on the other. In the spiritual universe there is a mutual attraction or aggregation of similar natures. The consequence is that Hell is in conjunction with the animal mind, and Heaven with the spiritual mind. The process of allowing the lower nature to dominate takes place according to complicated laws; and the process of redemption is no less subject to biological laws. A consideration of these points must be waived here. Suffice it to say that conjugial love figures as the principal factor. By the state of that love men are judged, and gravitate to Hell or rise to Heaven. In adulterous or Scortatory Love, from which Hell is, are to be recognized a series of degrees, each lower psychologically than the preceding, although from the legal standpoint this fact could not be ascertained. The highest degree is fornication; lowest is the "love of seducing innocencies" (in which the desire is to despoil innocence because it is innocence). These appear in the spiritual world as serpents. This whole system might be termed transcendental phallicism, and is according to the author the primitive religion of man from which have arisen all forms of mythology by a degradation of self-consciousness into the sensory plane of life. The law of sexual health and vigor is plainly stated to be the cultivation of love to God.

We turn at this point to the subject of sexual hygiene.

Effect on Women of Imperfect Hygiene of the Sexual Function. TAYLOR. Am. Jour. Obstet., Vol. XV, No. 1, Jan., 1882.

Three out of every four married women suffer from sexual ill health due to ignorance before and after marriage. A nervous state or loss of tranquility has come with civilization. Girls utterly fail to connect erotic sensations with the reproductive organs and yet these feelings are deeper in the female than in the male. This last fact explains why restrictions for preserving chastity are more stringent as applied to girls than to boys. The result of all this repression of the physical feelings leads to an intensification of the more intellectual emotions; esthetic crazes and the like being the outcome. Morbid self-consciousness, fears, loves, morbid desires, a fondness for love stories, all exemplify a life run to emotion and never culminating in executive work. An inflamation and congestion become chronic, and disturb the health of the entire body. The obvious remedy is first, education and knowledge, so that the true nature of these feelings may be realized, and second, engagement of the mind in some occupation,—work, the grand remedy for all troubling thoughts of this or similar nature. In the male (see Taylor, "Genital Irritation," Annals of Anat. and Surgery, July, 1881), genital irritation caused by phimosis is frequently the cause of as serious a train of troubles, leading often to self-abuse, sometimes to reflex paralysis of the walking centers. No one can study a work on the treatment of sexual diseases both in man and woman, prepared for the medical practitioner, without being convinced that abnormal conditions here affect the body more profoundly than such conditions anywhere else. One might say with a considerable show of truth "*if your sexual life be pure and healthy, you are every whit whole.*"[1]

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[1] The reviewer desires to call attention to the fact that general inferences, criticisms, and the like are often incorporated with matter more strictly the teaching of the work under review, without being specially designated as extraneous,—a method, having advantages that outweigh its defects, when authors are second in importance to their ideas.

The effect of the body and mind upon these organs is likewise as profound; and finally their abuse is more easily accomplished and is more direful in its effects than the abuse of any other organs. These physiological observations tally well with the morphological theories that make the body either a modification of sexual cells, or an organ subservient to the reproductive organs. Many diseases that are apparently localized in some organ or other of the body and which fail to yield to treatment directed to that organ disappear miraculously when the treatment is directed to the generative organs.

In perhaps a majority of cases there is no definite disease, but only a general feeling of debility. In the field of quackery the treatment of sexual disorders naturally takes the first place, and ignorance is to be blamed largely for the existence of the diseases themselves and certainly for the encouragement quacks receive. This ignorance is universally deplored by all writers upon these subjects and referred to the very deep feeling of antipathy that exists toward the broaching of any subjects that suggest sexual relations. The feeling of shame has developed with such intensity in the highest civilized communities that all possible methods are used to conceal from consciousness the fact of sex. The feeling of modesty has undoubtedly been of use in the evolution of the race, but at the expense of occasional victims who fell because of ignorance. *The mistake is made in ascribing immodesty to knowledge.* Many writers are of the opinion that the opposition to the proper diffusion of knowledge of the laws of sexual hygiene among the masses comes most strongly from a prudishness that is the outcome of a mind not truly chaste. The following author dwells on the effects of prudish education.

Adolescence. Part I of " The Physiologist in the Household " series. FOTHERGILL. London, 1880.

The efforts to avoid certain subjects, unduly emphasizes them, "Virtue preserved by artificial contrivances is liable to fall." "Nothing but an entire revision of our educational arrangements for girls can give a girl a sure protection against her own passions." The subject of sexual precocity is treated at length. "From such conditions come the criminal classes. "One boy or girl can corrupt a whole school."

The Importance of Knowledge Concerning the Sexual Nature. GERTRUDE KITZ. Printed for the Washington Society for Moral Education. New York, 1884.

This pamphlet instructs superiors in regard to the proper training of children relative to these subjects. Some excellent suggestions are given. Other books recommended by the society are Dio Lewis "On Chastity," and Spencer "On Education."

Sex in Education, or a fair chance for girls. CLARKE. Boston, 1875.

Much of the ill-health of women is due to lack of care during each menstruation, and particularly the first one. But our schools for coeducation take no notice of this, and make the girls stand during recitation, climb stairs and pass examinations while the menstrual period is lasting. The nervous energies are whipped up to the highest pitch of excitement in our competitive prize contests, and the girl-graduate is a physical wreck. She should be taught to rest at every period; she should not be required to compete with boys in the same studies. Her education should be adapted to her nature and to her life work. This is not to be construed as an argument against coeducation of the sexes, but rather against "identical education." Jean Paul says, "To insure modesty, I would advise the education of the sexes together; for two boys will preserve twelve girls, or two girls twelve boys, innocent amid

winks, jokes and improprieties, merely by that instinctive sense which is the forerunner of matured modesty. But I will guarantee nothing in a school where girls are alone together, and still less where boys are."

This is the greatest argument for coeducation. The natural association of the sexes is the preventive of sexual perversion, (by the mutual interaction of souls, the mystic will say in explanation). The scandals of society are largely due to an ignoring of this law, and where similar cases arise in coeducational institutions, they have in all probability germinated outside, or are from diseased conditions inherited from parents who have themselves perhaps "been more sinned against than sinning."

There has been no lack of able works written for the guidance of the masses in sexual matters. For very young children (from 10—14) no literature is better adapted than the two following little pamphlets: "*A Father's Advice, a book for every boy*," and "*A Mother's Advice, a book for every girl*," by Dr. and Mrs. E. P. Miller respectively, New York, 41 West 26th St., 1881. Prof. Wilder's book, *What Young People Should Know*, has passed through several editions, and contains much biological matter about the evolution of sex in lower organisms that could profitably be incorporated into the common school physiologies.

The two following works, prepared by Dr. Napheys, are the best popular treatises extant:

The Physical Life of Woman, 426 pp., and *The Transmission of Life; or counsels on the nature and hygiene of the masculine function*, pp. 362. Philadelphia, 1887.

In these works general subjects like heredity, production of sex, etc., occupy special sections, and each chapter is followed by a bibliography.

In England, two corresponding works of marked excellence have appeared, viz.,

Advise to a Wife, by CHAVASSE, and *The Functions and Disorders of the Reproductive Organs, in Childhood, Youth, Adult Age, and Advanced Life*, by ACTON. Seventh Edition, 1888. pp. 263. Republished in Philadelphia, by Blakiston.

In addition to these, there have been numerous special publications, some of which are noted below, and in America mention must be made of the itinerant phrenological lecturers and a host of quacks, who have in their degree enlightened the public. Fowler's prolix *Science of Life*, is representative of this class, and from a moral standpoint is unimpeachable, whatever its scientific weakness. There has, therefore, been considerable teaching of the public in this regard, but of course in an incomplete, often perverted form. This suggests that text-books by competent authorities should be used by school teachers in private classes. The appendix to "*The Human Body*" (MARTIN) is a step in the right direction. The duties of parents are in no wise to be entrusted to teachers, for we learn that children of a tender age are frequently addicted to sexual vices, often most innocently falling a snare to their older associates. It is pretty certain that however carefully a boy is kept in ignorance of these relations, he is sure to learn from playmates and by overhearing conversation between men of unrefined nature, what is a very one-sided and degraded knowledge. Herein lies the necessity for proper training, which is perhaps the strongest force with which to combat certain social and solitary vices. There are also very lax and erroneous ideas extant about the injurious effects of continence, which are combatted by the following pamphlet:

A Physician's Sermon to Young Men. PRATT. New York. pp. 48.

The next pamphlet, a production of the pietistic sect of Germany, is

a model of its kind, and an example to other ministers of religion of how
to deal with subjects that so closely concern them as spiritual advisers.

Wahrnung eines Jugendfreundes vor dem gefährlichsten Jugenfeinde.
    KAPFF. Stuttgart, 1842.

Tissot and Zeller appear to be the mai₀ authorities upon which Kapff
has relied for information, but the method of treatment is original, and
a model of pedagogical insight.

We now approach a subject of the highest importance to the welfare
of a nation, viz., the family. That marriage is an institution for the
ultimate purpose of keeping up the succession of generations of man-
kind is the expression of the wisest and best thinkers of all times; but
there are firmly rooted in society views and practices that are subversive
of this end. Such practices include all forms of incontinence, prostitu-
tion, free-love, abortions, and all sexual relations in which the ultimate
purpose of reproduction is thwarted. In this connection we take the
following work as representative, although were it not for its great
popularity, it would not be worthy of consideration :

The Elements of Social Science ; or Physical, Sexual and Natural Religion.
    An exposition of the true cause and only cure of the three primary social
    evils, Poverty, Prostitution and Celibacy. By a DOCTOR OF MEDI-
    CINE. Dedicated to the poor and suffering. Twelfth Edition.
    Translated into many European languages. London, 1875. pp. 592.

The anonymous author professes to be a Comtist, and writes with true
religious fervor in favor of a better physical development ("physical
religion"). By sexual religion is meant the application of medical
means to cure sexual diseases. By natural religion he means the aboli-
tion of restrictions upon free love. The primary thesis is that the celi-
bate life is one of suffering, and matrimony is monopoly. That such a
book represents a most powerful pernicious influence, dangerous to
society, goes without saying. A simple inspection of medical works
like *Excessive Venery,* HOWE, New York, 1884, pp. 299, and others
reviewed below, will show that much of the misery and degradation of
society is traceable to the very things advocated by this author. The
injunctions of religion are justified by the principles of physiologi-
cal science. The *Symptoms of Sexual Exhaustion* are considered by
Beard in the May and June numbers of the *Independent Practitioner,*
1880. Such symptoms are, lack of mental control, defective memory,
irritable heart, wandering of attention, excitable pulse, dimness of
vision, morbid fears, softness or weakness of voice, sweats, cold hands
and feet, paralysis of will from anxiety, besides the legion of diseases
directly caused. Just what constitutes an abnormal exercise of the
reproductive functions leading to disease, and how such disease
is produced, is an unsettled and extremely complex problem, and
certainly offers a field for investigation.

The Jukes, a study in Heredity, Pauperism and Crime. DUGDALE. New
    York, 1877. pp. 120.

This interesting study of a large family of hundreds of criminals that
could be traced to a common ancestor who was a harlot, and whose de-
scendants were largely harlots and criminals, shows most vividly the close
association existing between prostitution and crime. Pauperism is shown
to be the result of weakness or sexual exhaustion. Among the valuable
conclusions reached the following may be noted : Early marriage tends
to extinguish harlotry. A favorable environment in early life may
counteract the tendency of heredity. Usually the heredity exerts itself
in creating an environment favorable to its own development. It is the

environment that works badly for the illegitimate child, for if favorably placed he may succeed. The diseases that cause pauperism are due to licentiousness. Induced pauperism, caused by the bringing up of a child in the poor-house, is easily reverted to, and becomes hereditary in the offspring. The illegitimate lines furnish the most criminals. Men become moral by patient training, leading to the organization of habit. Reformers should make reform easy; for development is in the direction of least resistance. The Jukes are sexually precocious. Many of the effects ordinarily termed hereditary are due secondarily to other forces that are alone truly congenital. Hence education can step in and direct the stream of development.

Le Marriage au point de vue de l'heredité. BATTESTI. Paris, 1886.

The main part of this brochure is devoted to stating and illustrating the laws of heredity. The author holds the view that mutilations and acquired characters may be transmitted. The subject of transmission of psychic conditions is quite fully treated. He is not in favor of early marriage; 25 for the woman and 35 for the man are optimal ages. Twice as many girls married before the age of 20 die, as of celibates, and that too in the face of the fact that celibates are often such from having weakly constitutions deterring them from marriage. Characters that develop late, and are confined to one sex, appear in the same sex and at the same age in the offspring; but characters that appear early in either sex are transmitted to both sexes. Syphilis is used as an illustration to confirm this law; but we fear that the author has not analyzed the question thoroughly enough. The outcome of the paper is, that a knowledge of these laws should govern in marriage. Unfortunately, all efforts to breed human beings fail, even after the obstacles that emotion throws in the way are overcome; as witness the failure of the Oneida Community. Natural choice is based upon attractions that represent real affinities between the persons in love, and this unreasoning choice is far wiser than the greatest learning could make any person at present. There is need of studying what this attraction is, to discover the laws that govern its operation. Even prostitutes form special attachments that are apt to result in fertility. A clear determination of the relations of love to fertility must have pre-eminent interest from a legal as well as a psychological standpoint.

The subject of divorce is painfully frequent in its exemplification, yet we are assured that only a fraction of unhappy marriages come before the public. Such a state of things shows a deplorable want of a high ideal among the masses as to the obligations and significance of the marriage contract. This wrong is not easily righted by legislation; but in the proper training of youth there is promise of better things.

Of the greatest importance also is the subject of abortion. An earnest protest was made in 1867 by Dr. Storer of Boston in two small books ("*Why not?*—a book for every woman," and "*Is it I?*—a book for every man"), in view of an alarming increase in this practice, the number of cases involved in the United States having been estimated by the hundreds of thousands. This could not happen were it not for the direst ignorance prevailing among the people, concerning the development of the embryo and the danger of interfering with the important functions of gestation. The subject has wide historical and anthropological bearings, as the following works show:

Die Geburt bei den Urvölkern. ENGLEMANN. Wien, pp. 197.

This work is a valuable exposition of obstetric methods used by uncivilized races. The Calabar Indians give drugs in the third month of pregnancy to test the viability of the fœtus. Should the fœtus survive there is great care taken to prevent mis-carriage. Such practices

show that abortion among savages h , a close association with savage infanticides, and it has a similar reason for being.

Zur Geschichte der Verbreitung und Methode der Fruchtabtreibung. PLOSS. Leipzig, 1883.

Abortion as well as infanticide is widely practiced among savages, the two being mutually supplementary. In New Zealand infanticide is more frequent. The Papuans think two children are enough and regularly destroy by abortion all the succeeding. In the Sandwich Islands one-fourth of the women are childless. A few of the Pacific Island groups are free from this practice. Both abortion and infanticide were frequent with the American aborigines. In Brazil one tribe of Indians regularly destroy the fœtus in women under thirty years of age. To have a family is a sign of old age and the women wish to be thought young. Among the Winnebagoes an average of one child per woman was found and two children among the Chippewas. Half-breed children are regularly aborted, their large heads being fatal to the mother. Among African tribes there is great variation. Abortion is less frequent than infanticide in India. Chinese medical works describe methods of securing abortion. Mohammedans do not believe there is any life in the fœtus before five months. In Persia abortion is contrary to religion. The methods of securing abortion are various; in the United States quacks advertise their trade in the public newspapers.

Facultative Sterilität. (With supplement). HASSE, (Pseudonym). Leipzig, 1883.

This pamphlet describes an instrument for producing abortion and the general conditions that justify abortions are discussed. It is to be feared that the methods are applied in cases that do not justify any such radical treatment. In general it may be stated as certain that the risks to the health and life of the mother are vastly greater in case of abortion than in natural birth. In the United States an admirable study of criminal practice has been made by Eli Van de Warker.

Affaiblissement de la natalité en France. NADAILLAC. Paris, 1886, pp, 150.

From a statistical study the author shows that there has been a steady decline in the ratio of births to population during the past century amounting to over 25 per cent. in France. A similar study of other countries shows that France heads the list in the amount of this decline. In 1884 the ratio of marriages to 1000 of population was 66 for France and only 60 for Paris, where the ratio of illegitimate to legitimate births was as 17 to 46. This decline can be due to the action of no Malthusian principle, because wealth has increased; but the standard of comfort has been raised. The author of Sexual Religion thinks his principles have made great progress in France and felicitates its people. Nadaillac sees in this enfeeblement of the birth rate a menace to the welfare of the country.

In the *Popular Science Monthly*, December, 1889, Grant Allen argues that the state of matrimony must for all time be the normal and necessary one for all women to enter and that our education for girls should be directed towards preparing girls to be good mothers. At present there needs to be four children born for every woman, to keep the race just stationary in numbers. Consequently every woman who chooses a celibate life is responsible for increasing the burdens of her married sisters. The fewer the children the better they will be reared and the more leisure for general culture there remains to the mother, all of which is much to be desired. We may modify this view to the extent of substituting two for four children per woman, because the excessive

infant mortality of to-day is largely, if not entirely, due to present ignorance of various laws of life. As many women naturally have large families it follows that there is plenty of room for women with intellectual pursuits, but the home must remain the keystone of society.

In closing we desire to draw attention to the vastness of the field of sex as a subject of investigation and the undoubted importance of the results of investigations in this line, not only in their bearing upon scientific and philosophical questions, but more especially as such results affect the general happiness and progress of the race. All other reforms really wait for sexual reform to lay the foundations. This reform has begun to take active shape in the world's work in such organizations as the White Cross League; and the old forces of prudery are beginning to weaken. There must however be more open and free delivery of facts before investigators in the field can make much progress. The laws of Natural Selection will vindicate the right by the constant destruction of lines of degeneracy as well as conditions of stagnant conservatism. One fact comes out clearly and that is that biology is the beginning of psychology, sociology and kindred sciences.

Appendix: While no attempt has been made to include all important papers bearing on these subjects, but rather to give a brief hearing to a few or sometimes a single work in each line, it was my intention to note Galton's work in heredity more carefully than was done in the first section. This author appears to me to have been led into a fallacy in considering that as we have two parents, four grand-parents, eight great grand-parents, etc., it follows that our distant ancestors are each represented by an infinitesimal factor in us. Our thesis is that the whole of each of all our ancestors is present in each of us, but that which is truly individual, i. e. our contribution to the continuous training of the generations of gemmules from Adam down, is infinitesimal. Consequently each of our parents passed over to us Adam's body (hereditarily) plus the increments successive generations had added to this ancestral stock. Almost the whole of the body of the father is therefore identical with as large a part of the mother's body, and the two coalesce as one in the child to form the oldest and best fixed of its characters. The child starts with this species-stock, plus all the increments that have been added on the father's and on the mother's side since their gemmules, which were once associated in a single remote ancestor, parted company, at first by cell division in the ovaries, etc., and later were still further separated by the development of these cells into distinct individuals. Such is an outline of the method of organic evolution, which may be completed by the addition of a few simple specifications, such as, that the characters in ontogeny are unfolded in the order of phylogenetic differentiation and that while thus unfolding, any portion of the history may be cenogenetically revised.

The following *errata* occur in the first section: p. 98, line 14 from bottom, "became" should be "become;" p. 102, line 11, "this" should be "the above;" p. 106, line 10 from bottom, "(cytic)" should be "(cyclic);" p. 108, line 8, "evolution is its" should be "evolutionists." The author of "La vie psychique," etc., is BINET. Lines 11, 9 and 8 from bottom, "experienced" should be "exercised;" "*nasutum*" should be "*nasutum*," "trichocytes" should be "trichocysts," "prendopodia"—"pseudopodia."   JULIUS NELSON.

Ein geschlechtlich erzeugter Organismus ohne mütterliche Eigenschaften. Dr. BOVERI. Gesellschaft für Morph. und Physiol. zu München. July 16, 1889.

Boveri brings forward a crucial experiment into the much disputed fields relating to the functions of nucleus and cell protoplasm and the parts

taken by the male and female nuclei in reproduction and heredity. The most direct way to ascertain whether the cell nucleus, the protoplasm, or both contain the elements which characterize the cell is to take the nucleus out of one cell and put it into the protoplasm of some other cell. This is what Rauber attempted to do when he interchanged the nuclei of toads' and frogs' eggs, his purpose being to see whether the protoplasm of the toad's egg would cause the product to take the form of a toad, or the nucleus of the frog's egg would shape the embryo to a frog, or whether both nucleus and protoplasm might act to produce a hybrid. Rauber's experiments failed, as might be expected in dealing with such highly specialized structures.

The year following, however (1887), the Hertwigs discovered that fragments of sea urchin ova containing no part of the nucleus might be fertilized, and they then segmented and developed like normal eggs or fragments which contained female nuclei. In order, then, to settle the question propounded by Rauber, it only remained to fertilize a denucleated fragment of the egg of one species of sea urchin with the spermatozoon of another species and keep the larva until it showed unmistakable specific characters. This is what Boveri set himself to do. The species which he found to suit his purpose are *Echinus microtuberculatus* and *Sphaerechinus granulatus*. Thus not only different species but different genera were employed, and easily recognizable characters make their appearance in the forms of the skeletal spicules by the third or fourth day, and Boveri was able to keep the larvæ for a week.

If, now, a large quantity of *Sphaerechinus* ova are shaken in a test tube with milt from *Echinus*, many of the ova will be broken and some of the fragments will contain nuclei, others not. A part of the ova remain intact and but few of these are fertilized. The nucleated and denucleated fragments, however, are fertilized in great numbers, and give rise to *dwarf larvæ of two entirely distinct types*. One class of dwarf larvæ shows an exact middle form, and since the same form, not dwarf, may be obtained from cross fertilizing intact ova, it is safe to assume that this type is developed from *nucleated* fragments. This is no more than we should expect, an intermediate form, where a cross of this kind can be effected. The interesting fact now comes to light that the other large class of dwarf larvæ *conform wholly to the male type*. This whole class must arise according to Boveri from a male nucleus developing within a *denucleated* fragment. All his attempts to demonstrate this by isolated cultures failed, but the author considers it sufficiently proved by the large numbers of male-type larvæ which made their appearance in the gross cultures, by the distinctness of the two types, and also by the interesting fact that the cell nuclei in dwarf larvæ of the male type, as shown in sections, were only about half the size of ordinary nuclei. The experiments are further confirmatory of the Hertwigs' observations and on the whole there seems little ground to doubt their validity. The experiments of Boveri, then, prove: *First*, that in this particular case, at least, the nucleus alone conveys specific characters to the offspring, and that the cell protoplasm, although essential to development, has no formative influence whatever. *i. e.*, "protoplasm is nutritive but not formative" (Weismann). *Second*, that in the above mentioned species the male and female nuclei are approximately equivalent in formative power.

The truth of the first has long been supposed, and many facts in the development of the subject point significantly toward the truth of the second proposition. The very discovery by Van Beneden (*Recherches sur la Maturation de l'Œuf et la Fécondation*. Arch. de Biol. Gand, 1883, pp. 265–640, 13 pl.), that the chromatin loops or filaments are equal in the male and female nuclei argues strongly for its validity, as

also the work of Platner (*Die Karyokinese bei den Lepidopteren als Grundlage für eine Theorie der Zelltheilung.* Internat. Monatschr. f. Anat. und Hist. III, 347–587, 2 pl., Leipzig, 1886), in showing that important steps in the perfecting for conjugation of male and female nuclei are identical. In short no difference of male and female can be discovered in the nuclear structure of male and female reproductive cells by any known method. This has lead to the oft repeated statement, "chromatin is not sexed." As the writer of this section might put it: ultimately male and female protoplasms are different only in past experiences, and such differences are not observable with a microscope.

At first thought such a case of male parthenogenesis as is brought to light by Boveri's experiments seems to invalidate all theories of sex which would make the male and female factors in reproduction fundamentally different; for example, the well-know theory of Dr. Brooks that the female is in general more conservative than the male while the male tends to vary more than the female. "If a perfect animal could be developed" says this author (*Heredity*, p. 102), "from the spermatozoon of a male parent, as it can be, in cases of parthenogenesis, from the ovum of a female parent, we should have a means of proving that each sex transmits its entire organization to its offspring." "The phenomena of parthenogenesis, or reproduction by virgin females, as in the case of bees and wasps, show that the ovum alone may transmit all the established hereditary structure of the species, but there is and can be no evidence that the male element can accomplish the same thing," (p. 125). It now appears that the spermatozoon is able to do what it seemed safe enough to assert to be impossible in the nature of the case. But it must be admitted that we should not resort to the stable and ancient *echinodermata* to study variation and especially any variations which may depend upon sexual differentiations. It may well be that the male has been specialized to function as a progressive or variable factor in some species and not in others. Such an experiment as Boveri's, however, seems to preclude the universality of a principle of this kind; and still this very experiment proves more than the equivalence of the male and female element; the male nucleus being able to build up its entire structure; while the female nucleus, accepting Whitman's theory of polar globules, is able to make only a feeble effort at segmentation. This would seem to indicate a prepotency in formative power on the part of the male nucleus, which may be confined to certain species or may be a general characteristic, hitherto not so clearly revealed, but present in all male reproductive nuclei.

The work of Boveri certainly opens a new line of experiment in this interesting field. The method must be applicable to other forms, and until more experiments of the kind are made, it is useless to attempt to reason further as to the general bearings of his discovery upon questions of heredity and sex. C. F. H.

VI.—MISCELLANEOUS.

Die naturwissenschaftlich-psychologische Weltauffassung der Gegenwart, von Dr. HERMANN WOLFF, Dozent an der Universität Leipsig, 1890. (2 vols.)

Whatever criticism may be made of the work before us, it is certainly large in range; and as its title indicates, represents some of the most recent phases of philosophic and scientific thought. Zeller says, that through the great development of the sciences new questions arise for solution, new means are required, and a partial change from the former experience of philosophy is possible; and so it must enter into closer relation with the sciences. The recent investigations on the organs of sense and the brain make necessary a renewed proof of the psychological and

metaphysical foundations of idealism. Exclusive idealism must be supplemented by a healthy realism. Wundt says, that philosophy must take as its foundation the whole range of scientific experience; then it will be the science of sciences in the true sense of the word. Science has incontestably the ruling interest of the day; and with reason, because of the exactness of its method and the certainty of its results. But science at its zenith ends with unsolved problems. These limits are in the words of Du Bois-Reymond: (1) inertia, matter and force; (2) the inconceivability of a passage from the mental to the material; (3) the origin of motion; (4) the genesis of life; (5) the arrangement of the world according to a purpose; (6) the origin of rational thought, and of language; and (7) the problem of free will. And Hæckel rightly says, that these phenomena are not fully explained by heredity and selection. This lies in the fact that our knowing faculty is absolutely limited and has only a relative extension. It is conditioned above all, by the nature of our sense-organs and brain. Bunge in his treatise on physiological and pathological chemistry also says, that the mechanism of the present brings us with certainty to the vitalism of the future, but that the essence of this vitalism consists in a going out from the known, the inner world, to explain the unknown, the outer world. The above ideas are an acknowledgement from the side of science itself, that its continuation and completion must be found in philosophy. Science without philosophy ends in unsolved problems; philosophy without science lacks a sure foundation. Both are children of the same mother; both work for the solution of the same secrets. But in what philosophy shall science find its continuation and consummation? It is the very nature of science to rest on experience; and this philosophy therefore must be based on facts; in a word, purely empirical. With such a philosophy only, can science go hand in hand. Such a philosophy, the author says is set forth in this work. The foundation of ethics (treated of in the second volume) must come from the results of science and philosophy; the proof of truth must be derived from metaphysics (sit venia verbo). The moral act expresses the deepest nature of humanity, and is inseparably connected with the sense-phenomenal and psycho-metaphysical nature of man. Morality cosmologically considered brings to light the essence of man; and thus the investigation of moral problems leads to the study of anthropology, cosmology, psychology and metaphysics. In order that the whole may have a logical connection and a systematic unity, the author investigates in like manner the object as the methodological problem, the transcendental problem and the epistomological. He then considers the analysis of the Microcosmus, that is, of the individual man according to his physical and mental content, as expressed in the conscious *ego*. This is followed by an analysis of the Macrocosmus, both of the organic and inorganic part. Since here is shown how the being and functioning of the objective world is imaged again in scientific consciousness, this part also can be designated as a microcosmus in subjective relation with the first part as a microcosmus in objective relation. A unified system of philosophy with the name of "empirical psychical realism" will be, as Hæckel says, the philosophy of the future; and is nothing further than a complete system of monism.

Les lois de l'imitation; Étude sociologique, par G. TARDE. Paris, 1890. pp. 431.

In this work the author has endeavored with as much clearness as possible to bring out the purely social side of humanity; abstracting that which is simply vital or physical. But he finds, that the point of view, in favor of which he could mark this difference, shows between the social and natural phenomena the most numerous, constant and natural analogies. This pure sociology is general; its laws are applicable to all actual, past or possible societies, just as physiological laws

are to all species. The philosophy of history and the philosophy of nature, as generally understood, present the historical and natural phenomena in such a way as to preclude the possibility of a wholly different grouping or succession.

The real is only explicable by being attached to the immensity of the possible, that is to say, of the necessary under conditions, where it swims as a star in infinite space. The idea of law is the conception of this firmament of facts. Certainly all is rigorously determined, and the reality could not be different, its primordial and unknown conditions being given. But why these, and not others? There is irrationality at the basis of necessity. Also in the physical and living domain, as in the social world, that which is realized, seems to be only a fragment of that which can be realized. The mind does not admit the relation of cause to effect, except where the effect resembles the cause, repeats the cause; as an undulation gives rise to another similar undulation. Each time that " produce " does not signify to "reproduce," all becomes dark to us. There is only science of similitudes and phenomenal repetitions. (1) All the similitudes in the chemical, physical and astronomical world have for their explanation and possible cause periodic and vibratory movements. (2) All similitudes in the vital world result from hereditary transmission, from intra or extra-organic generation. (3) All the similitudes of social origin are the direct or indirect fruit of imitation in all its forms: custom, sympathy, obedience, instruction, education, social imitation or reflective imitation. In short, every social similitude has imitation as its cause.

A social group may be defined, as a collection of beings in so far as they are imitated among themselves, or, without actual imitation, in so far as they resemble one another, and their common traits are ancient copies of the same model. Society is essentially imitation. The brain is an organ which repeats sensitive centers, and is itself composed of elements that repeat themselves. Memory is purely a nervous habit; habit is a muscular memory. Thus every act of perception supposes a sort of habit, an unconscious imitation of one's self by one's self. Society is a memory, a habit not individual, but collective. What is the nature of this imitation, of this suggestion that constitutes the mental life? We do not know. For if we consider this fact in its purity we are brought to a phenomenon, much studied at present: somnambulism. If one will read the books of Richet, Binet et Féré, Beaunis, Bernheim and Delbœuf, he will be convinced that it is no fancy to regard social man as a veritable somnambule. The social state, like the hypnotic, is only a form of dream. Sympathy is mutual imitation, mutual prestige, according to Adam Smith; prestige is at the base and origin of society.

From archeological and statistical considerations, history may be defined, as a collection of things that have been done most; that is to say, initiatives that have been imitated most. History is the destiny of imitations.

Considered logically or teleologically, (1) internal models will be imitated before external, and (2) examples of persons, or classes, or localities considered superior will take precedence over the inferior, and (3) superiority is sometimes attached to the present, sometimes the past, and is a powerful cause of favor, of a considerable historical influence, as examples of our fathers or of those of our contemporaries.

This imitation from the within to the without signifies two things: (1) That imitation of ideas precedes that of expression, (2) that imitation of purpose precedes that of means.

The classes or nations which are imitated most are those in which imitation is the most reciprocal. A large city is characterized by an intensity of internal imitation in proportion to the density of population and the multiform multiplicity of the relations of its inhabitants. Thus

there is an epidemic and contagious character given not only to its diseases, but to its styles and its views. Aristocratic classes were once remarkable for an analogous character, and to an eminent degree the royal courts.

After considering, from the point of view of imitation, language, religion, government, legislation, usages and needs, morals and arts, the author finishes his work with some general remarks and corollaries :

The supreme law of imitation appears to be its own tendency to an indefinite progression. This sort of immanent ambition, which is the soul of the universe, and which is transformed physically by the luminous conquest of space, vitally by the claim of each species to fill the entire globe with its examples, seems to push each discovery or each invention (even the most insignificant individual innovation) to scatter itself indefinitely in the whole social field. But this tendency, when not seconded by logically and teleologically auxiliary inventions, or by the favor of certain prestiges, is hindered by diverse objects. These obstacles are either logical and teleological contradictions, or barriers which a thousand causes, principally prejudices and pride of race, have established between families, tribes and peoples. It results from this that a good idea, arising in one of these groups is propagated without trouble, until it reaches the frontiers. But fortunately this arrest is only slackening of pace. War is often more a civilizer for the conquered than for the conqueror, for the former often borrows its ideas from the latter. Each germ of imitation in the brain of the imitator, under the form of a belief, aspiration or idea, develops into exterior manifestations, into words, actions, which are impressed upon the nervous and muscular systems according to the law of march from within to without. Each act of imitation makes each new act more free and rational, more precise and rigorous. These conditions are the gradual suppression of barriers of caste, class and nationality ; the gradual diminution of distances by the rapidity of locomotion and the density of population. Suppose all these conditions reunited and pushed to the highest degree, the imitative transmission of a good initiative over all humanity would be almost instantaneous, like the propagation of a wave in a perfectly elastic medium. We are hastening to this strange ideal, and already we meet indications in the world of savants, where although far separated, they touch each instant by mutiple international communications.

Psychopathologie des Bewusstseins für Aerzte und Juristen, von Dr. F. C. MÜLLER. Leipzig, 1889. pp. 190.

The author considers first the nature of consciousness itself, taking up the different theories of the concept " consciousness " from the medical, legal and philosophical standpoint. He then studies the conditions in which consciousness experiences a derangement, or is abolished; and concludes with a short résumé of the different opinions as held by physician and judge in respect to these exceptional conditions of the *psyche.* Consciousness is a function of our mental life and communicates with the outward world through the organs of sense. Its elements are the representations that it changes into concepts. Its location is in the brain; it can perceive and reproduce; it is the relation of a single changing cerebral act to the whole content of the brain. The highest grade of consciousness is self-consciousness; then come personal consciousness, time and space-consciousness, and world consciousness. In pathological cases, the result of the unconscious cerebral mechanics penetrates to consciousness, then it is in general unconsciousness; or it is grasped indirectly by self-consciousness, then it manifests itself as hallucination or as executed impulsive action. Finally the functions of consciousness, to wit, attention, reflection, artistic reproduction can be wholly nullified as in fever delirium, epilepsy, alcohol-intoxication and

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dementia. In the chapter on intoxication, the author mentions, among other poisons, opium, morphine, chloral-hydrate, chloroform, cocaine, ether and alcohol; and says that none work so often and with such degenerative results as alcohol.

Three points are emphasized: (1) The concentration of the poison; it makes a great difference whether one drinks beer, light wine, or whisky. (2) The momentary condition of the individual can be greatly modified by hate, love, joy or sorrow. (3) The outer surroundings, as great heat or great effort.

In 1874, in Germany, there were 32,837 prisoners of whom 13,706 were drinkers, of these last, 7,269 were occasional drinkers, and 6,437 habitual drinkers. In the last chapter is given a short and clear consideration of the legal side of insanity in different times and countries. In ancient times hypnotical, hysterical and epileptical persons were looked upon as supernatural, as possessing powers; but the middle ages tried them for witchcraft; the psychically abnormal man was in continual danger of being sacrificed at the stake. But modern legislation has brought a change.

Stammbaum der Philosophie, von den Griechen bis zur Gegenwart. Dr. F. SCHULTZE. Jena, 1890, (14 tables).

This work is a most complete and thorough tabulated plan of the history of philosophy up to the present time. Like a traveling guide to the voyager, it will be of practical value in hearing lectures or in reading large works on the history of philosophy. It gives the foundation thoughts in the philosophical development in general and of each system in particular. It is especially useful for review and for preparation for examination. The last and most interesting table, on the development of philosophy since Kant, gives the names and points of view of not only modern philosophers, but those at present living. This last point would be of special value to one proposing to pursue philosophical studies in Europe. The tables on the rise and development of Christian thought, and on the church philosophy of the middle ages are valuable for students of theology.

Pawnee Hero Stories and Folk-Tales. GEORGE BIRD GRINNELL. New York-Forest and Stream Publishing Company, 1889.

In the present volume Mr. Grinnell gives the results of his interesting investigations on the customs and beliefs of the Pawnee, the bulk of the book being a collection of tales and traditions. The second part of the work contains a most interesting description of Pawnee life and customs, as observed by the author during his long and frequent stays among this tribe. We mention the chapter on religion, in which the subjects of belief, ceremonies and mystery are treated separately, as particularly important. When referring to the ethnological affinities of the tribe the author places the Pawnees erroneously with the Tonkaway and Lipan, with whom they are in no way related. The interest of the book centers in the chapter on folk-tales which the author collected in the spring of 1889. He has endeavored to retain as much as possible of the original form of the tales. He has succeeded in telling them in an attractive form, although they retain throughout the stamp of the peculiar culture of the Indians. Here is the most formidable difficulty to the collector of Indian myths and tales,—to make his book intelligible and readable, and still not to introduce ideas foreign to the mind of the Indian. Certainly the only way that seems free from most objections is the collection of Indian texts, and even here the individuality of the observer makes itself felt. But if we should confine ourselves to this method, all hopes of a sufficiently extensive collection of American lore would have to be abandoned, as the number of languages is a

formidable obstacle to a successful carrying out of such a plan. The most notable among the tales recorded by the author are those referring to the Nahurac, animals in human shape, who live at certain places underground, where they have their council lodges. They are endowed with supernatural power and it is told how they restore men to life and from them are derived the teachings of the secret societies.

The Cherokee Ball Play. JAMES MOONEY in the American Anthropologist, Vol. III, p. 105.
Cherokee Theory and Practice of Medicine. JAMES MOONEY. Journal of American Folk-Lore, Vol. III, p. 44.

These two articles which the author publishes as an earnest of the results of his investigations among the Cherokee, carried out under the auspices of the U. S. Bureau of Ethnology, bring out in the most emphatic way the close connection between religious life and the customs of ordinary life among primitive men. Mr. Mooney describes in great detail the ceremonies connected with the ball play, which seem to have escaped all former observers. There is a myth according to which the bat and the flying squirrel at one time helped the birds to win a game of ball against the quadrupeds. Consequently their skins are considered powerful amulets for ball players. The players are trained, but have at the same time to go through certain performances of a religious character, abstaining from certain food and certain occupations, ceremonial bathing and bleeding. The night preceding the game a dance is held by the whole tribe in which men and women take part and which has evidently a religious significance.

The author records the ever-recurring idea that diseases are believed to be produced by witchcraft or by the influence of spirits; but what is most curious is the method of selecting certain cures for specific diseases that are considered to be due to natural causes. The connection between the medicine and the disease treated is generally that of some analogy, real or fancied. Thus heart-troubles are believed to be due to the lungs becoming wrapped around the heart. Fern is used for treating these diseases, "because the leaves when young are coiled up, but unwrap as they grow older."

On poisoned arrows in Melanesia. R. H. CODRINGTON. Journal of the Anthropological Institute, Nov. 1889, p. 215.

We learn in this paper a curious example of the conception of poison in primitive man. In certain parts of Melanesia arrows are used which are smeared with vegetable juices, that are generally considered to be poisonous. According to the native theory the actual poisonous principle of the weapon is the point which is made of human bone. After a man is struck by such an arrow, the ghost of the person whose bone was used in making the arrow gains control over the wounded person. The enemy who wounded him makes certain incantations and consequently the ghost kills his enemy. The method of treating the wounded is quite analogous. The ghost is kept from the hut in which the sick person lies, by means of rattles made of shells which are fastened to the roof of the hut. The bone is extracted from the wound and kept at a cool place as a prevention of fever. The enemies on the other hand, will heat the bone and drink hot, irritating juices, in order to bring about inflammation of the wound.

Climatic Influences in Primitive Architecture. BARR FERREE. The American Anthropologist, Vol. III, p. 147.

Everywhere a certain connection between climate and architecture may be observed, even among civilized people. This influence is far more evident among primitive people. In warm climates man may

content himself with a simple rectangular wall for protection against the wind. In colder and windy climates he will endeavor to make the walls of his abode impermeable for the wind and avoid all unnecessary openings. In rainy climates pitched roofs are used very generally, or other devices are applied which serve the purpose of carrying off the rain. Difference in material of construction is principally due to geographical causes. Lack of wood led to the development of the art of using skin and, later on, clay. The author passes in review a number of similar phenomena, and points out the importance of sociological facts in the development of architecture.

Erfahrungen zur Entwickelungsgeschichte der Völkergedanken. K. VON DEN STEINEN. Globus, Vol. 56, p. 11.

The author of this ingenious paper has won well deserved renown by his expeditions through the interior of Brazil and the conclusions which he draws from his wide and varied experience will not fail to attract the attention of anthropologists. He claims that "animism" necessarily developed, as soon as man began to speak, because the similarity of speech and the production of sounds by other beings must lead to this belief. He assumes, and this is, we believe, an original idea of Von Steinen, that a limitation of the idea of animism followed the invention of instruments, of objects which do not develop or come into existence, without the co-operation of man. The author believes that when objects were first made or modified by man, according to the will of man, the idea of causality first originated. We do not see quite clearly why such should have been the case, as animism is certainly an attempt at explaining the phenomena of nature. Besides this, utensils were considered by many primitive tribes as possessing souls, sometimes even more than stones, wood and similar natural objects. The *aperçu* gives a number of ingenious ideas which supplement those developed by Spencer and other authors.

The Psychology of Prejudice. Prof. G. T. W. PATRICK. Popular Science Monthly, March, 1890.

Prof. Patrick explains the phenomena of apperception, with ample illustration and agreeable style, especially in the fields of opinion and action, where they appear as prejudice and habit.

European Schools, or what I saw in the Schools of Germany, Austria and Switzerland. L. R. KLEMM, Ph. D. International Education Series. Vol. XII. New York, 1889.

This note-book is of unusual value. The author records facts not theories, describes concrete lessons not school curricula, and, instead of padding his book with pedagogical platitudes, gives three or four hundred pencil sketches of educational devices, samples of pupil's drawing, and the like, personally observed. A large part of the book is devoted to German schools. The work described shows that in Germany the effort is made to base education upon psychology, and that the teachers have at least learned to utilize the spontaneous interests of children. The description of the School for Dullards at Elberfeld, and the concrete examples of work done at the *Francke Stiftungen* are of special psychological interest.

Zur Psychologie der Taschenspielerkunst. MAX DESSOIR. Nord und Süd, Heft 155, 1890. pp. 29.

In this very readable essay Dessoir has attempted an analysis of the points of psychological interest in the performance of the ordinary stage conjurer. The essay begins with an historical sketch of conjuring and conjurers, showing the steady improvement in the tone of these

performances, an improvement largely consisting in the substitution of psychological for purely mechanical modes of deception. The successful tricks of to-day are in their construction essentially psychological. They are arranged so as to precisely imitate the condition of affairs under which the most natural inference would be the true one, and yet the circumstances really make it as false as possible. Of course manual skill always has been, and still is, one of the essential requisites, but manual skill alone never makes a conjurer of the highest order. The by-play and the mode of presenting a trick so as to divert attention from the real doing of it are far more important; the truly great conjurer produces an atmosphere of confidence in what he says and does, and at the same time such a feeling of bewilderment and astonishment that the simplest trick is invested by the spectator with a halo of the miraculous. To illustrate these general principles a number of tricks are analyzed and a number of the rules of the trade are brought together, all tending to show the psychological insight of these adepts at deception. To simulate the ordinary forms of perception and inference, these must be correctly understood both objectively and subjectively, and hence the importance of the psychology of deception.

Recherches sur les mouvements chez quelques jeunes enfants. A. BINET. Revue philosophique. Mars, 1890.

The observations of M. Binet cover four topics: tne movements of walking, bilateralism, automatism, and reaction-times. The age at which a child begins to walk is not fixed and certain, but depends on its strength and many other circumstances among which the psychic character of the child (its power of attention) has a place. Binet like Preyer finds these movements not acquired by imitation, but instinctive. In a baby only three weeks old, so held that the soles of its bare feet received the stimulus of contact, he noticed the alternate movements of walking. In another child of about the same age the movements were not to be observed; in still others, however, even younger they were seen. Spontaneous movements in very young children are almost always bilateral, (simultaneous or alternate) as any one may prove to himself by counting, but are almost entirely unilateral in a child of three years. Some of the actions that Binet describes as *automatic*, *e. g.*, the unconscious closing of the hand when an object is placed in the palm, seem more properly reflex. Between these and the automatism of double-personality cases, the author suggests a possible similarity, though he would not press it too far on so few observations; also between the preservation of attitudes (as when a child remains immovable in the midst of some action half performed, because its attention has suddenly been diverted) and the fixed attitudes of catalepsy. In the infant this splitting up of the psychic activities into independent groups would be a sign only that the fixed systematizations of the adult mind were yet to come. The reaction-times of children from three and a half to seven years old to sound, registered with a Marey tambour, were from .440 to .660 sec., against .140 for grown persons using the same apparatus, results similar to those reached by Herzen. The maxima and minima were .750—1.300 and 190—200 respectively, and the reaction-times quite irregular. The contraction made in response seems to last longer with the child than the adult and to reach its maximum amount less quickly. The most rapid rate of closure of the thumb and finger upon a rubber tube was for children 7-12 in four seconds, for adults on the average 18. Binet observed in a child less than three weeks old, who had never been allowed to fall, an instinctive dread of being held in an insecure position.

Education of Laura D. Bridgman.

Almost the only sources of first hand information in regard to the beginnings of Laura Bridgman's education are the reports of Dr. Howe,

which have for a long time been practically inaccessible. These have now been collected and reprinted in a volume of 233 octavo pages, with a preface by Julia Ward Howe, and a brief obituary notice of Laura Bridgman by another hand. Besides the reports, the book also contains a number of paragraphs upon various aspects of Laura's condition and training, found among Dr. Howe's papers and probably intended by him as notes for his own use in the preparation of a contemplated book upon this subject. It is a matter for congratulation on the part of pedagogy and philanthropy alike that these original records of a masterpiece in both have been collected and republished. There is no publisher's name upon the book, though it can probably be obtained from the Perkins Institute for the Blind, South Boston, Mass.

Versuche über den zeitlichen Verlauf des Gedächtnissbildes. Dr. J. PANETH. Posthumously communicated by Prof. Exner. Original-mittheilung; Centralbl. f. Physiol., Bd. IV, No. 3, 10 Mai, 1890.

The interesting question of the rate at which the memory images of sensation fade has several times been made a subject of experiment; as early as 1851 E. H. Weber tested it for weights and the length of lines. Later experimenters in several instances have found the strange result that for sensations to which attention is given the decline in exactness is hardly appreciable, and with these the experiments of Paneth range themselves. He worked on the memory of time intervals ranging from a fraction of a second to several whole seconds, the strength of the memory image being measured by the ability to reproduce the given standard interval after a longer or shorter pause. The pauses varied from a fraction of a second to five minutes, and within these limits the fading of the image was scarcely to be appreciated. Toward an explanation of this persistence, the like of which Exner reports to have been found in the case of areas and of intensities of light in yet unpublished experiments of Dr. Wahle, it is suggested that the quantitative relations of any sensation to which we give attention are immediately registered in their proper places in the great mass of recollections already present, and what is afterward recalled is not so much the original sensation as these places. The "primary memory image" of a sensation, if unfixed by attention, is a very transient affair.

La morphinomanie. BALL. Paris, 1885.

Morphinomania holds the same relation to morphinism that dipso-mania does to alcoholism; but dipsomania is intermittent, while morphinomania is continuous. The effects of opium upon the intellect are slight at first, but hallucinations come in later that may rise to acute mania as, *e. g.*, the "running a muck" of the Malays. The drug has a paralyzing effect upon the organs of vegetative life, and the moral sense is obliterated. The habit once formed, abstinence causes the same painful symptoms as abuse. Opium, hashish, tobacco, alcohol, tea and coffee seem to have many characters as nervines in common. As stimulants, they produce euphoria; excessive use (and abstinence after moderate use) causes insomnia, motor troubles, hallucinations, delirium, etc. The sexual passions are enfeebled; a temporary abstinence acts aphrodisiacally. The strength of the dose needed to produce full effect requires to be gradually increased in case of opium, sometimes a decrease as small as one-twentieth of a centigram is felt keenly. Two methods of cure are used. A sudden cessation accompanied by careful nursing and medical attendance, is short but risky; and the author recommends the gradual diminution of the dose even if the cure is protracted and painful. Tonics should be given, but nothing stronger than coffee. The paper concludes with an interesting review of cases of *"folie gemellaire"* in which twins, even though separated, were

attacked in precisely the same way at the same time, and the development of the mania leading to suicide was parallel in the two persons. Cases of this sort show a great susceptibility to nervous contagion. Cases of similar dreams in two or more individuals more or less in the same physiological state have been known.

PSYCHOLOGY IN AMERICAN COLLEGES AND UNIVERSITIES.[1]

PSYCHOLOGY AT THE UNIVERSITY OF WISCONSIN.

BY PROFESSOR JOSEPH JASTROW.

Courses: (A) General course in Psychology for such students as take no other Philosophical work. Fall term: daily (about 65 hours); largely elementary work by recitation. Prof. *Stearns* has the class half the time, taking general topics in Psychology, and such as have a philosophical bearing. Murray's Handbook of Psychology is used as a basis in this work. My own part of the work is by lectures, covering the following ground: (1) The Senses (following Bernstein's Five Senses of Man), laying stress upon the psychological interpretation of sensations; (2) the Nervous System treated somewhat as in Carpenter's Mental Physiology, ch. II., not in detail and with some comparative and developmental considerations, and laying stress upon reflex, automatic (and secondary automatic), and voluntary acts, as well as on the general discussion of higher and lower centers and localization, (1 and 2 cover about three-fifths of the course); (3) the Psychophysic Law and Experimental Psychology, accentuating the importance of methods and the relations between the senses; (4) Time Relations of Simple Mental Phenomena, simple reaction, distinction, choice, association, etc.; (5) Experiments with Higher Mental Processes, memory, attention, association of ideas, etc.; (6) Animal Psychology (1 lecture); (7) Infant Psychology (1 lecture); (8) Morbid Psychology: diseases of speech, of memory, of will, of personality (Ribot) as illustrating normal Psychology (3 lectures); (9) Anthropological Psychology (1 lecture). Only such experiments and demonstrations are performed as can be shown to a large class at once: the simple phenomena of sensation, with models of sense-organs, simple reaction-time experiments, and the like. The class last autumn numbered ninety-seven.

(B) Advanced Psychology: Lectures two hours weekly, and one afternoon in the laboratory for winter and spring terms; about forty-five lectures and half as many demonstrations in laboratory. Students must have taken course (A) to enter course (B). Ladd is used as a reference book for students. The topics are covered in a very much more thorough manner than in course (A), and in all points in which the same topics occur in the two courses the elementary parts are hastily reviewed and the topics then resumed. As far as practicable each student repeats for himself all experiments and observations. A list of topics in order is as follows: (1) Nervous System, covering the ground in Ladd, sections are examined, models used, and the simpler physiological experiments performed; (2) Senses, with very full tests of experiments, the students making the usual designs for the stereoscope, rotating discs, color experiments, test weights, etc.; (3) Reaction-times as in course (A), but more detailed, and with variety of experiments; (4) Psycho-

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1 It is only fair to state that the accounts given below were for the most part received by the editor two months ago.

physic Law: full experimental treatment; (5) Experiments with Higher Processes. This experimental portion occupies the entire winter term. Topics taken up in the spring term are: (1) Comparative Psychology (attempts will be made to have a few instinct studies going on); (2) Morbid Psychology, including psychic research problems and defectives (visits to neighboring insane asylums are contemplated); (3) Anthropological Psychology (Tyler as basis); (4) Psychological Theories. One afternoon in each week is devoted to the tests above mentioned, to demonstrations or other laboratory exercises. Where the topic does not admit of such illustrations, a lecture or report upon literature will be substituted.

At present the library facilities are inadequate, but my own library is at the disposal of students.

The laboratory consists of one large room on the second floor of Science Hall, and an ante-room for quiet, undisturbed work. It is proposed to fit this also as a dark room. Apparatus is constantly being added. We have in use now the following: Hipp chronoscope with fall apparatus, also long fall apparatus of my own construction; Yung triple rotating apparatus, two full sets color discs, etc., Yung clock-work for rotating discs; Holmgren color-blindness test, Joy-Jeffries color-blindness chart, Oliver test-letter chart, Snellen's Optotypes, apparatus for testing blind-spot (own construction), model of eyes in motion, six stereoscopes, Wheatstone stereoscope, two æsthesiometers (own construction), two muscle sense apparatuses (own construction), apparatus for bilateral asymmetry, two pressure sense apparatuses (our construction), Verdin rotating drum, Marey tambour, Deprez signal, three metronomes (with Marey attachment), Féré dynamometer (with Marey recording attachment), Savart's wheel, color contrast apparatus, psychophysic law apparatus, colored papers, drawing instruments and usual supplies. Many of the instruments of the physiological department, especially models, are used.

Laboratory work: Besides the weekly demonstrations and the repetition of experiments by students, original research is undertaken under my personal guidance. Students meet by appointment and do as much as time allows. I spend three entire afternoons in the laboratory throughout the year. A Fellow in Psychology and Philosophy has been appointed. Private research is engaging several advanced students. The "Studies" which have been printed in this JOURNAL give an idea of this work. An evening Psycho-philosophical Seminary is contemplated. Plan: one-half term to a selected topic discussed throughout the season; other half to literature, mainly that of the periodicals.

PSYCHOLOGY AT THE UNIVERSITY OF NEBRASKA.

BY DR. H. K. WOLFE.

In the University of Nebraska the first attempt to introduce the study of Physiological Psychology and Psychophysics was made in the fall of '89. As a preparation for the specific work of the year a course of five general lectures on the following subjects was given: 1, Philosophy; 2, Psychology; 3, Biology; 4, Embryology; 5, Development of the Individual Human Nervous System. Ladd's Physiological Psychology was recommended as a guide, and, except in the succession of topics, represents the work done by the average member of the class. During fourteen weeks about one-half of the text was completed. The subject will be continued one term longer for the general student, and will be followed by special work for those desiring it. References were freely given to THE AMERICAN JOURNAL OF PSYCHOLOGY, *Mind, Philosophische Studien;* to Foster, Gray, Balfour, Wundt, Schwalbe, Hermann (Handbuch), *et al;* yet only occasionally was work outside of text book

required of the student. Considerable extra text work was required where Ladd's treatment was deemed too brief, as in reflexes, development, and especially the sense-organs of sight and hearing.

The class room work was informal, having for its object the elucidation of obscure points rather than the discovery of indolence and ignorance in the student. As aids the department has (a) a set of Marshall's charts and numerous home-made drawings (chiefly embryological), besides several hundred painted squares and discs for color sensations; (b) Azoux's Synthetic Preparation of Brain, Eye, and Ear; (c) Hipp's chronoscope; (d) the nucleus of a psychological library. Several pieces of apparatus for original research are in process of construction. Not a few instruments belonging to the departments of Biology and Physics can be used as required.

For the term beginning Jan. 2d there were offered; (a) the continuation of Physiological Psychology; (b) a four hour course in Experimental Psychology; (c) a special course of lectures on Sight. Next year (a) and (b) together with a course on Pedagogical Psychology will extend throughout the year.

Besides assisting in the cultivation of the general student, it is expected that this department will render material aid to scientific pedagogy; furthermore, that its work will have a practical bearing on methods in the public schools of the state. The plan includes, therefore, three more or less distinct objects, viz.: general cultivation, pedagogical foundation, original research. It is intended to equip the laboratory as fast as funds can be obtained. After next year post-graduate work and opportunity for original research will be offered; the lecturer has considerable material on hand, and is now engaged on a subject of apparent fertility.

DEPARTMENT OF PSYCHOLOGY AT THE NEW YORK COLLEGE FOR THE TRAINING OF TEACHERS.

By W. L. HERVEY.

As the New York College for the Training of Teachers is a professional school where none but professional branches are pursued, Psychology is studied solely as a branch of Pedagogics. Only so much of Philosophy, Physiology and Rational Psychology is introduced as is necessary to enable student-teachers to derive the principles of Pedagogic Science. The data for these fundamental principles are gained partly by reading and lectures but largely by induction by the class from personal experience and from observation of children. At the beginning of the second term of the first year students are given blanks, with definite time and opportunity to study the children and record observations. To aid them further in finding out the contents and workings of children's minds, sets of questions, which suggest ways and means of investigation, are placed in the hands of all. A large Model School in connection with the College affords ample opportunity for profitable work in this direction. The special Kindergarten students are also required to make definite record of all observations in the course of their almost constant intercourse with children. It is thought that this study of children, which has hitherto been largely overlooked, will result in important contributions to educational science.

PSYCHOLOGY AT COLUMBIA COLLEGE.

By Professor NICHOLAS MURRAY BUTLER.

Psychology is one of the subjects included in the work of the philosophical chair and up to the present time has not been organized as an independent department. This is a step in advance which it is hoped to take in the near future. Up to the present time no laboratory or

apparatus has been provided for the study of Experimental Psychology, but the present incumbent of the philosophical chair (who has been at the head of the work for but a short time) has already laid the matter before the President and Trustees and hopes to secure within a few months not only a specialist in Experimental Psychology, but a well-arranged laboratory and a fair stock of apparatus. When this has been accomplished, it is the intention to organize a thorough course of three years in Experimental Psychology modeled after the best American and European courses. The first year of this course will be elective for members of the senior class in the college; the two remaining years will belong to the graduate or university work. Of course the laboratory and apparatus will also be available for independent investigation and research by specialists attached either to this or other institutions. Arrangements are also well under way by which the results of any original observations or experiments may be promptly published by the department. It is hoped that this course, when established, will be specially attractive to many of the students in the medical school of the College.

The library facilities are and will continue to be unexcelled. As rapidly as possible the standard psychological works, journals and reports are being collected, and funds will not be wanting to supply any reasonable demand of this kind.

At the present time only the introductory part of the course referred to is being given, and that without any adequate supply of apparatus or illustrative material. The instruction is wholly by lecture and covers the general relations of body and mind, the gross anatomy of the cerebro-spinal system, the anatomy and physiology of the end-organs of sense and of motion, and the simpler problems of cortical localization and of psycho-physics.

PSYCHOLOGY AT HARVARD UNIVERSITY.

BY PROFESSOR WILLIAM JAMES.

The Corporation of Harvard University have recognized the position of Psychology as an independent science, by creating a new professorship bearing its name. Professor *William James* was appointed Professor of Psychology last December; and it is hoped that the department will start next fall with a laboratory amply furnished and endowed, and the beginning of a library for the exclusive use of its students and additional to the University library. These so-called departmental libraries are already in existence in many of the branches of instruction at Harvard. This year the psychological instruction is in the hands of Professors *James* and *Royce*, who each give to the undergraduates a course in Logic and Psychology for three hours a week throughout the year. The Psychology occupies about six of the eight months during which lectures last. Both instructors use Ladd's Physiological Psychology as a text book, and accompany it with comment and experimental demonstration. The subject is decidedly popular with the students, 175 of whom have elected it this year.

The graduate course is given by Professor *James*, this year to six graduates, and to two seniors specially privileged. The method is the so called seminary-method, no two men doing just the same work. Brain-anatomy, however, forms an obligatory part of the course, and human brains are dissected instead of the sheep's brains used by the undergraduates. The class meets two hours weekly at the Professor's house for lecture and discussion, and the students do their laboratory work at special individual hours. This course lasts two years. Two of last year's students attend this year. The papers by Mr. Delabarre in this JOURNAL (Vol. 2, pp. 326, 636) are fruits of last year's work.

PSYCHOLOGY AT YALE UNIVERSITY.

By Professor George Trumbull Ladd.

Any fairly complete account of the study of Psychology at this University should include the following particulars :—

A. An Elementary Course. This course is prescribed for all Juniors in the Academical Department; it covers three hours of class-room work a week during the entire year,—if, as in my opinion is certainly just, we include under the head of Psychology those mental phenomena ordinarily assigned to formal logic, logical praxis, and descriptive ethics. It is taught by Mr. *Duncan,* with the free use of several text-books; and it is designed to open the field before the students, and enable each man intelligently to choose whether he will accept or reject the offers of further work in the subject.

B. Supplementary and Allied Courses.—During the same (namely, the Junior) year, and for a year following, several courses in biology may be pursued. These cover the ground of experimental inorganic and organic chemistry, especially of physiological chemistry under Professor *Chittenden,* of human physiology, and of comparative anatomy and histology under Professor *S. I. Smith.* The courses are all conducted with a large amount of laboratory work, demonstrations, illustrative experiments, and lectures. Nearly all the men who take my course in physiological psychology have these courses, four hours a week, for two entire years.

In this connection should be mentioned certain work done in the Sheffield Scientific School and in the Medical School. In the former, Professors *Chittenden* and *Smith,* with the aid of their pupils, are constantly making and publishing researches in physiological chemistry and biology. In the latter, Professor *Thacher's* work in physiology, and the work of Professor *Lee* in histology, are worthy of special mention.

C. Advanced Courses.—With a class composed partly of undergraduate and partly of graduate students, I go over the ground covered by my "Elements of Physiological Psychology." This course is two hours a week for an entire year. Part I of the book is supplemented by lectures and demonstrations from charts, a complete set of the Boch-Stéger models, and a small but choice selection of histological preparations. For displaying the preparations I find one of Zeiss' hand-microscopes, with objectives and eye-pieces that enable me to go as high as 250 diameters, exceedingly convenient. In teaching Part II I have to rely upon charts (illustrating optical illusions), machine for mixing color-sensations, etc. I regret to say that Yale has not yet established a separate laboratory for researches in experimental psychology.

Dr. *Porter,* whose work of teaching has for several years lain largely in the line of ethics, offers at present an advanced course in psychology. It is designed to afford the student opportunity to re-examine with a critical spirit some of the questions which have been raised by the earlier study of psychology. I have also a course, two hours each week for the entire year, which takes up the psychological problems anew for discussion from the philosophical point of view. Mr. *Duncan* has a somewhat similar course,—though briefer and with less attention, perhaps, to the philosophical implications.

In Pedagogics, as considered from the point of view of psychology, I have a course, which perhaps should be mentioned in this connection.

I do not think it in place to mention apart several other courses in philosophy, and the history of philosophy, taught by lectures and by "seminary" methods, in which psychological and ethical problems have a prominent part. Nor need there be more than a reference to most of the large amount of work in physics, chemistry, biology, comparative anatomy, histology, anthropology, neurology, etc., which is going on in

the several departments of this University. I will only add that Professor *Hastings* has been making special researches in optics, which are soon to be published; and that Professor *Sumner's* course in anthropology, in which Ratzel's *Völkerkunde*, Lippert's *Kulturgeschichte*, and Ranke's *Der Mensch* are used as text-books, with illustrative lectures and detailed study of special topics, is deservedly popular.

The facilities of the library are on the whole very good, although it does not by any means contain all the past and current works on Empirical Psychology. The great "archivs" and quarterlies and reports—anatomical, physiological, biological, etc.—are well looked after; it being the policy of the library to accumulate a collection of such books. Within reasonable limits I can have ordered what I desire. My private library contains a good many of those smaller (but sometimes very valuable) monographs, which a large public library is apt to overlook.

PSYCHOLOGICAL AND ANTHROPOLOGICAL APPARATUS NOW ACCESSIBLE TO STUDENTS IN WASHINGTON, D. C., IN THE OFFICE OF THE SURGEON GENERAL.

Psychological and Physiological Tests. Set of whistles of Galton to test hearing, Cattell's reaction time apparatus, æsthesiometer of Jastrow, kinesimeter of Hall and Donaldson, Jastrow's instruments for measuring muscular sense (Nos. 1 and 2), Salter's dynamometer to test pull, Salter's dynamometer to test squeeze, Galton's apparatus to test swiftness of blow, Galton's test type, Galton's test of estimating squareness, Galton's test for judgment of eye, optometer of Taval, optometer made by Giering & Co., Snellen's phakometer.

Experimental Physiology. Kymograph, Keyt's compound sphygmograph, and four others, Kuhne's "optical" eye.

Instruments to Measure the Living. Wooden rod on standard for stature, etc., Mathieu's anthropometer (Broca's pattern), British weighing and measuring machine (by Casella, London), height scale after Galton, scale for span of arms after Galton, Broca's graduated plank for anthropometry, Broca's directing square for anthropometry, Broca's exploring square for anthropometry, conformateur (as used by hatters), two pair of chest calipers, Kluge's pelvimeter, cephalometer of Antelme.

Instruments for Measuring Skulls. Spengel's craniometer, Virchow's craniometer, Virchow's steel caliper, millimeter wheel, steel measuring tape, caliper of three branches, ordinary caliper, gliding caliper of Broca, Flower's modification of Broca's caliper, steel rulers in inches and centimetres, Topinard's projecting board, Topinard's craniophore, Topinard's large square, Topinard's small square, median facial goniometer, facial goniometer, parietal goniometer of Quatrefages, mandibular goniometer, apparatus (old fashioned) for studying *foramen magnum*, iron craniophore, projecting board for long bones (with goniometer).

Instruments for Drawing Skulls. Drawing apparatus of Lucæ as improved by Spengel with two orthoscopes, apparatus of the Army Medical Museum with three periglyphs, endograph, craniophore for holding crania to be photographed, stereograph of Broca, apparatus to draw axis of ends of humerus to estimate its torsion, instruments to take internal capacity of skulls, bronze standard skull of Ranke.

Set of Instruments and Materials for Shot Measurement. Hunting shot No. 8, shot jar, two-litre measure, two tin pans, two ring-shaped mats, rammer, wadding, one-litre measure, one-litre graduated glass, wooden operculum for the same, funnel (2) small, funnel (5) large, leather jacket for frail skulls, machine to drop shot into the litre can.

Set of Instruments and Materials for Water Measurement. Scales, weights, ether spray apparatus, shellac, adhesive plaster, putty, simple

cerate, lard, linseed oil, bread board, rolling pin, water vessel with tubing and stopcock, half-gallon measure, pan with lip, metronome, 2000 c. c. graduated glass, wiper for the same, insufflator, powdered lycopodium. instruments to remove putty, thermometer; also, for use when required to replace either method, a quantity of mustard seed.

PSYCHOLOGY AT THE UNIVERSITY OF PENNSYLVANIA.

By Professor James McKeen Cattell.

Special courses in Psychology are given by Professor *Fullerton* and the writer. Professor *Fullerton* is giving this year two courses, one for undergraduates, the other for graduate students. In these courses special stress is laid on psychological analysis, and those regions of Psychology which border on the theory of knowledge. The writer gives three courses extending through the year; an introductory course in Experimental Psychology, a course beginning with the special study of some psychological problem, and taking up in the second half year Comparative, Social and Abnormal Psychology, and an advanced course in Physiological and Experimental Psychology. These courses include either practical work or research on the part of the student. A lecturer on Philosophy and an assistant in Psychology are about to be appointed, and additional courses will be given next year.

In addition to these special courses, Physiological, Abnormal and Comparative Psychology may be studied in the Medical and Biological departments of the University. These are probably without rival in America, and offer complete courses of lectures, practical work and clinics. Psychology borrows from and lends to all the sciences. Everyone of the large number of advanced courses offered by the University bears some relation to Psychology, and may prove useful to the student. Attention should also be called to the libraries, scientific and art collections, zoölogical and botanical gardens, literary and scientific societies, etc., of Philadelphia. The asylums and hospitals will be found of special advantage to the student of Psychology.

The new library building of the University is nearly completed. There is a special endowment for the purchase of philosophical and psychological books, and any books needed by students for special work will be obtained. The University press is about to begin the issue of a series of monographs. representing work done in the fields of Philosophy and Psychology. The first number, now in press, is a psychological study on "Sameness and Identity," by Professor *Fullerton*. Following this number will be a series of researches from the Laboratory of Psychology, and an edition of Descartes' "Meditations" with Latin and English texts and philosophical commentary.

It is possible that the readers of the American Journal of Psychology may be interested in some details concerning the Laboratory of Psychology, and the researches now in progress. The writer believes that the chief work before Experimental Psychology is the measurement of mental processes. As Experimental Physics is devoted to the measurement of time, space and mass in the material world, so Experimental Psychology may measure time, complexity and intensity in consciousness. In so far as cases are investigated in which one mental magnitude is the function of another, a mental mechanics is developed.

The laboratory possesses apparatus, which measures mental times conveniently and accurately. This apparatus has been described in *Mind* (No. 42), but since then it has been improved. The chronoscope has been altered and a new regulator made, so that the mean variation of the apparatus is now under one-thousandth of a second. New pieces have been built for the production of sound, light, and electric stimuli. Apparatus for measuring the rate of movement and for other purposes

has been added. The observer is placed in a compartment separated from the experimenter and measuring apparatus. With this apparatus researches are being carried out in several directions. Professor *Dolley* is measuring the rate at which the nervous impulse travels, using two different methods. In one series of experiments an electrical stimulus is applied to different parts of the body, and a reaction is made either with the hand or foot. The rate of transmission in the motor and sensory tracts of the spinal cord has thus been determined. In a second series of experiments two stimuli are given at different parts of the body, and the interval between them adjusted until the observer seems to perceive them simultaneously. It is thought that these experiments will throw more light on human physiology than cases in which the nerve (motor only) of a partly dead frog is artificially stimulated. The times are also of interest to Psychology, as they are needed in order to determine purely mental times. Mr. Witmer is measuring the personal difference in reaction-times, and the work will be extended to different mental processes. These times seem to vary with age, sex, nationality, education and occupation, and their study may have practical value as well as theoretic interest. Length of life should be measured by rate of thought. Experiments are also being made on the variation in the reaction-time from hour to hour and day to day. With the co-operation of Dr. Weir Mitchell and other eminent neurologists the alteration in the time of physiological processes in diseases of the nervous system is being studied. It is believed that such tests may be of use in diagnosis. The nervous impulse may be sent through the system in different directions until a relative delay discovers the diseased part. Recovery and progression may be studied by noting the alteration in time.

Owing to the introduction of cerebral surgery and the advances recently made in the treatment of diseases of the nervous system, any method which may make diagnosis more exact deserves careful study. In addition to the time of physiological processes in disease, other tests of loss of sensation, power and intelligence, are made in the laboratory. The following ten tests are recommended; the methods, etc., are described in an article now in press for *Mind:* 1, dynamometer pressure; 2, rate of movement; 3, sensation-areas; 4, pressure causing pain; 5, least noticeable difference in weight; 6, reaction-time for sound; 7, time for naming colors; 8, bisection of a 50 cm. line; 9, judgment of ten seconds time; 10, number of letters remembered on hearing once. These determinations are made not only on those who are suffering from disease, but also on every one who wishes to be tested. It is hoped that the same tests will be made elsewhere, so that the results of a large number of observations may be compared and combined. The undergraduate students in Experimental Psychology undertake a course of laboratory work in which about two hundred tests and measurements are made. It is hoped that when a sufficient mass of data has been secured, it will have some scientific value. In the cases of two of the tests given above, The Rate of Movement and The Pressure Causing Pain, researches are being carried out in the laboratory. By altering the distance and nature of the movement, and the point of the body to which the pressure causing pain is applied, new quantitative results are obtained.

Professor *Fullerton* is carrying on a research to determine the rate at which a simple sensation fades from memory. A stimulus is allowed to work on the sense-organ for one second, and after an interval of one second, a stimulus slightly different in intensity is given for one second, and the least noticeable difference in intensity is determined by the method of right and wrong cases. The interval between the stimuli is then altered, and it is determined how much greater the difference between the stimuli must be in order that it may be noticeable. The

rate of forgetting is thus measured in terms of the stimulus. Intervals varying from one second to three minutes have been used. For these experiments new apparatus was constructed, and it was discovered that when sensations of light are successive and last for one second, the least noticeable difference in intensity is not about one one-hundredth, as is supposed, but much the same as for the other senses under like conditions. Other observations, such as the importance of keeping the time of stimulation constant, the stronger stimulus coming before or after the weaker, the degree of confidence, the personal and daily variation, etc., have made a new investigation of the least noticeable difference in sensation necessary. This is at present in progress, while further work on memory must wait for its completion. Mr. DeBow is in the mean while making experiments determining the time of stimulation giving the greatest accuracy of discrimination.

The rate, extent and force of movement is the subject of a somewhat extended investigation, which will not be completed for some time. The maximum rate of movement has been noticed above. Experiments on the maximum pressure have been published, as also on extent of right and left handed movements. But the least noticeable difference in the rate, extent and force of movement has never been studied in the same way as the least noticeable difference in passive sensation. Yet it would seem to need such study even more, owing to the importance and obscurity of the "sense of effort."

The laboratory possesses apparatus for studying the time, intensity and area of stimulation needed to produce the just noticeable sensation and a given amount of sensation. These mental magnitudes are correlated so that one may be treated as the function of the other. The results of studying the relation of time to intensity have been published in *Brain* (pt. 31), it being found that the time colored light must work on the retina in order that it may be seen, increases in arithmetical progression as the intensity of the light decreases in geometrical progression. The relation of area to intensity and time is now being studied. Other experiments on the relation of intensity, time and area of stimulation, as determined by the length of the reaction-time, and accuracy of discrimination have been begun.

The laboratory has a valuable collection of Kœnig's apparatus for the study of hearing and the elements of music, and a spectrophotometer, a perimeter and other pieces for the study of vision. Work on hearing and vision has been begun in several directions, but is at present delayed for lack of workers. Some progress is, however, being made in studying the fusion of sensations of light, the laboratory possessing special apparatus by which colored surfaces of given areas may in any succession work on the retina for given times. Mr. Newbold, who has been helping with the experiments on memory, is about to begin a research on attention, and it is hoped that next year there will be others ready to undertake original work. Among the subjects for which apparatus has been secured, and preliminary study has been made are: the building of complex perceptions, exertion and fatigue, the measurement of contrast, the association of ideas, and subconscious mental processes.

I have written more frankly than is usual concerning researches not yet ready for publication. My wish is to secure co-operation in applying scientific methods to the study of mind. We have at the University of Pennsylvania good collections of apparatus and laboratory facilities, and these we shall gladly place at the disposal of any one prepared to use them. But the chief thing is that the work be done; where it may be done is unimportant.

PSYCHOLOGY AT INDIANA UNIVERSITY.

BY PROFESSOR W. L. BRYAN.

As regards the work in Experimental Psychology in Indiana Univer-

sity:—1. When orders now out are filled, we shall have about $500 worth of apparatus, including Hipp chronoscope, Marey chronograph with the attachments to both for studying reflex and reaction time. 2. I have been left practically free to make a course of study, except that it is expected to cover fairly the field of Philosophy for undergraduates. I have accordingly organized the work (except one term in Ethics), around the Theory of Cognition and Method of Science. The elementary work in Psychology and Logic has this direction. A year's work in the History of Philosophy is chiefly the history of theories of cognition,— viewed as a sociological development. I have only left for undergraduates one-third of the time for Experimental Psychology. I shall study such parts of Physiological Psychology as throw light upon the personal equation in its most specific and in its more general meaning. Post-graduate students, of whom I have several, will of course work altogether in this line. 3. After the elementary work, there is a review of the results of Physiological Psychology,— at present following the line of Ladd, though of course not confined to that. The larger, including the current, literature is constantly accessible, and is brought to the attention of students. They are encouraged to take collateral work in Biology and in Physics.

PSYCHOLOGY AT CLARK UNIVERSITY.

By Dr. E. C. Sanford.

The work in Psychology and allied topics at Clark University during the past year has embraced the following topics: Anatomy of the Central Nervous System, Experimental Psychology, Anthropology, Criminology, and the History of Philosophy.

In the way of instruction, Prof. *Donaldson* has delivered a weekly lecture on the first topic, giving special prominence to the embryological aspect and to the relation of structure to function, illustrating the lectures with models and diagrams and following each with dissections, demonstration of sections, exhibition of plates, etc., etc., as might best serve the elucidation of the points in hand. He has also for a portion of the year conducted a weekly seminary upon the history and more general aspects of the question of cerebral localization.

The instruction in Experimental Psychology, under Dr. *Sanford*, has consisted of two courses; one a weekly lecture during the first half year on the time relations of mental phenomena, treating the subject rather minutely and with occasional demonstrations; and the other, a course now in progress (weekly) on sight, taking up in a more general way the vision of color and space perception, with more frequent demonstrations.

Dr. *Boas* has delivered two courses, lecturing twice a week; one on the Anthropology of North America (the Eskimo of the north coast, the Pacific coast tribes, those east of the Rocky Mountains), the other on Methods of Anthropological Study. He has also conducted a weekly seminary for several weeks on "Shamanism."

Dr. *MacDonald* has lectured during the latter part of the year on Crime and Modern Theories of the Criminal.

Dr. *Burt* has lectured through the year on the History of Philosophy, at first on Greek Philosophy and afterward on Modern Philosophy before Kant. He has also conducted a seminary in which twelve dialogues of Plato were subjected to a careful and critical reading with special reference to the development of the author's conceptions; later the categories of Aristotle have been taken up.

Dr. *Cook* has also lectured on the Genetic Character of the History of Philosophy from Locke to Kant. The press of other duties has unfortunately prevented the head of the department, Dr. Stanley Hall, from

taking a personal part in the work of instruction. He lead the seminary, however, for a time in the study of Reflex Action and met a number of men for a time in informal conferences.

In the way of original work and research by instructors and students: In the Neurological department, the question of the relation of the growth of a limb to the growth of its nerves and nerve centers has been studied, and progress made with an exhaustive examination of the brain of the celebrated blind deaf mute, Laura Bridgman; experiments have been continued on the effect of stimulation on ganglion cells, a portion of a history of Reflex Action has been written; and histological work has been undertaken on the cerebellum of the cat. In the Psychological department work is under way on the relation of the reaction-time to the muscular character of the response, on the relation of the concept to the simple sensations upon which it rests, and on organic memory in judgments of rhythm and time. The instructor in Anthropology has expended most of his time for research in the working up of data previously collected. Besides this original work the laboratories in each department (and especially in the last) have been used for practical work of a demonstrational character by students who propose to take up research work at a later period or whose lines of immediate interest were in other but related branches.

It is the desire of the University to provide all necessary facilities for research, and the laboratories have been furnished with that in view. The Neurological laboratory consists of two rooms, one large and one small, supplied with the reagents, apparatus and conveniences for histological and neurological work. In the way of illustrative material the laboratory has Æby's and Azoux's models of the brain in man and Ziegler's of the brain in lower animals, and a set of serial sections through the human brain is now in the making. The psychological laboratory (one large and two small rooms) is especially strong in apparatus for time measurements and psychological optics, having already or in construction most of the standard instruments of Wundt, besides many others of Donders, Snellen, Hering, Holmgren, Bowditch, et al. For the study of other chapters of Experimental Psychology a considerable collection of apparatus has been made and will be added to from time to time. The anthropological laboratory (two rooms) has all the essential instruments for anthropometry and craniometry. The library collection of books on all these subjects is carefully selected; all the important current periodical literature is accessible.

Next year the lectures in Neurology will continue upon the central nervous system and sense organs, though the scope and character of the course will be dictated in large measure by the wants of those that attend it. The lectures in Experimental Psychology will treat first the senses of hearing, taste, smell and touch, afterward the psychophysic law, memory, attention, etc. Those in Anthropology will cover methods, especially craniometry, the anthropology of Africa, and American myths. Work will also be continued in the history of philosophy, under Dr. C. A. Strong, though its precise character is not yet certain. Dr. Stanley Hall with the assistance of Dr. W. H. Burnham will conduct a course in Modern Aspects of Education.

PSYCHOLOGY AT THE UNIVERSITY OF TORONTO.

By Professor J. Mark Baldwin.

The students' work in Psychology here has been hitherto general and theoretical. The new curriculum, however, as now ratified by the University Senate, provides for more special and advanced courses and opportunity for research. The recent fire in University College postponed the equipment of the psychological laboratory which the writer had in view, but in the plans for the new buildings more ample accommodations are secured. The new laboratory is to be in the restored

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building in a retired portion of the first floor immediately over the rooms of the physical department. It will comprise two communicating working rooms, each 16 by 21 feet, a professor's private room, to be used also as a special psychological library under charge of a fellow or instructor, and a dark room available from the resources of the physical laboratory. The first two rooms will be separated by a hall from the latter two. This part of the building will be ready for occupation, it is hoped, in the course of the next academic year. The equipment, apparatus, etc., may be delayed in consequence of the present severe tax upon the resources of the University, but special researches will be prosecuted with the aid of adapted apparatus kindly loaned from the very complete collections of the departments of Physics and Biology.

The courses in Psychology for next year are : (a) Pass course in General Psychology on the basis of the writer's Handbook of Psychology and Sully's Outlines, two to three hours a week throughout the year. (b) Honor course in Historical Psychology and Theory of Knowledge. (c) Honor course in Experimental Psychology; first, theoretical, based upon Ribot's German Psychology and Ladd; and second, practical, involving laboratory work as soon as the laboratory is ready for occupation. All students in this course will be required to become familiar with the methods and simplest problems of Physiological Psychology, and questions for advanced study and research will be set for students who show the proper aptitude. (d) A course in the Physiology and Histology of the nervous system with special reference to Localization and Mental Disease is to be offered by Prof. *Ramsey Wright*, of the Biological School. This course serves as preparation for course (c) and for original work on advanced topics. (e) Seminary for reports and discussions of actual researches in hand — meeting weekly. The design is to encourage serious endeavor and stimulate interest in the outlying questions of the sciences, principally among post-graduates. Private facilities will be given whenever possible for experiments in Psychometry and Psychophysics. Of the under-graduates only honor men of the fourth (senior) year will be admitted. It is hoped that the work may be expanded to include problems in Medical and Abnormal Psychology, since the city and provincial institutions present abundant facilities, but nothing in this line has been projected as yet.

During the past year the students of the department have formed a "Psychological Society" for discussion and presentation of papers, conducted entirely by themselves. The object of the society is breadth of information rather than new work. They treat psychological questions, however, quite apart from speculative philosophy.

The library was totally destroyed by the fire, but the new collection is growing rapidly, especially in this department, owing to the notable generosity of friends at home and abroad. In another year it will probably be more complete in psychological publications than before. We are under especial obligations to the editors of *Mind*, *Journal of Speculative Philosophy*, and the AMERICAN JOURNAL OF PSYCHOLOGY for back sets of their respective journals. The new library building as now contemplated is to provide seminary rooms for several of the University departments, one of which (the philosophical seminary room), is to be added to the laboratory rooms mentioned above.

The teaching force is at present the writer and a fellow. After next year Prof. *J. G. Hume* is to assume his duties, and a post-graduate scholarship in Philosophy is to be established in memory of the late Prof. Young. Thus four at least will be the official force in charge.

The following are the subjects of researches now in progress : "Beginnings of Voluntary Movement in Childhood," "Sense of Effort," "Recognition"—together with special topics for the writer's proposed volume on "Feeling and Will."

NOTES.

If further evidence were needed of the vigor and development of the new psychological movement, it might be found in the inauguration of the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, the first number of which appeared on April 20 of this year. The editors are Ebbinghaus, Professor of Psychology at the University of Berlin, well known for his elaborate experimental study of memory and for his researches on sensations of light, and Professor König, of the same university, for some time assistant to Helmholtz, and the author of important studies in the perception of light and color. As co-laborers appear nine of the strongest men in the new movement in Germany: Aubert, Exner, Helmholtz, Hering, Kries, Lipps, G. E. Müller, Preyer and Stumpf. If great names mean anything, the new journal is assured a leading place. The number before us contains in eighty pages brief contributions from nearly all these investigators, psycho physical optics predominating, as will be seen below. Each article is, however, the treatment of a minor point (interestingly and scientifically done in most cases, to be sure), and there is not a *magnum opus* in the lot. How this will be in the future, remains to be seen.

HELMHOLTZ: *Die Störung der Wahrnehmung kleinster Helligkeits-unterscheide durch das Eigenlicht der Netzhaut.* — It is a well known fact that the sensibility for small difference in the intensity of light falls off as the lights to be compared become very bright or very faint. This is to be accounted for, in the first case, by the after-effects of the stimulus, and, in the second case, by the subjective light of the retina. The value found for this last by Volkmann is too small, as observation and experiments (by reducing the sensibility of the optic nerve by means of electrical stimulation) can show. The subjective light further disturbs by its unsteadiness and granular or blotchy distribution. The major part of Helmholtz's paper is a mathematical discussion of the effect of this blotchy distribution on the discriminative threshold, with especial reference to the experiments of König and Brodhun. The formula reached admits of adaptation also to the variation produced by very intense stimuli, and a table calculated by this formula shows a very satisfactory approximation to the results of experiment. In speaking of the vision of objects by very faint light, the author relates the following interesting observation. In his sleeping room, which is so thoroughly darkened that the outline of the window cannot be made out when the moon is in the opposite part of the sky, and the only things to be seen are the flecks of his retinal light, he can yet see his white shirtsleeves when he moves his arms. Considering that this happens when the source of light, the window, is quite invisible, it is a most surprising observation. A number of possibilities suggest themselves, but the actual objective character of the vision appears from the fact that when the hand was stretched toward the window and moved to and fro, its shadowy outline, and even that of the fingers, could be seen more distinctly than when stretched the other way. The meaning of this in a word is that a large faintly luminous surface *at rest* may fall quite below the intensity of the retinal light, and yet furnish enough light to show smaller objects *in motion*. The

relatively rapid changes produced in the retinal sensations by such familiar and voluntary bodily movements as those of the arm are easily distinguished from the ordinary fluctuations of the subjective light.

HERING: *Beitrag zur Lehre von Simultankontrast.*—Though further demonstration of the non-psychological nature of simultaneous contrast is coming to seem to Hering like slaying the dead, he allows himself to offer the crucial experiment recorded in this paper, demonstrating that the color received by the eye is what makes the contrast, and not that received by the mind. He furnishes a different color to the mind from that furnished to the eye, by the use of binocular color-mixing, and if a psychological explanation is to be found for what he sees, it will have to be one that includes a different psychical reaction in the two halves of the visual apparatus to the same perception. The setting of the experiment is in outline as follows: Two inclined plates of colored glass are set up, something as for Ragona Scina's experiment, but inclined toward each other like a roof, so that each eye looks through a different plate, the left, for example, through a red glass, the right through a blue one. When the necessary conditions are fulfilled, the observer sees the white ground below the plates, not in the color of either, but in the color of their binocular mixture, namely a whitish violet. If now a strip of black paper is placed on this white ground in the median plane, and the eyes are fixed on a point some distance above it, the strip will appear double and at the same time, under proper conditions for showing simultaneous contrast. If the psychological explanation was correct, both images should appear a yellowish green. As a matter of fact, the one seen by the right eye with the blue glass appears yellow, that seen by the left eye with the red glass, green. The experiment in this form, however, does not exclude successive contrast. To avoid that, a sheet of black paper is laid over the whole of the white ground and the black strip, and the observer, having allowed his eyes to recover fully from previous color-sensations, puts himself in position and suddenly draws away the black paper. The colors immediately appear as before. (A practiced observer can reverse the experiment by a half-minute's steady fixation, followed by the restoration of the black paper. The left eye then sees a red, and the right a blue after-image of the strip, on a faint olive ground.) It might, perhaps, be objected, that the blue-green image of the left eye would be yellow-green (as it should be on the psychological theory), except for the binocular mixing-in of the blue sensation received by the corresponding points of the right eye, and that the yellow image of the right eye would be yellow-green, except for the red sensation received by the left eye. To this it is to be replied theoretically, that the conditions are not such as to favor the binocular mixing of the general color of one field with the image of the strip in the other eye, and experimentally, that making both plates red or both blue does not make the images of the black strip appear grayish, as it would if there were such a mixture as this objection supposes.

FECHNER: *Ueber negative Empfindungswerte. Letters written to W. Preyer, between 1873 and 1883, and now edited by him.*—This portion of the correspondence seems to have arisen from the close resemblance between the myophysic law which Preyer had determined for the extent of the contraction of a muscle under varying intensity of stimulus, and the psychophysic law of Fechner. The mathematical formulæ lead in both cases to negative values. These Preyer would entirely disregard, making his law extend no further than actual phenomena. Fechner, on the other hand, preferred to follow his formula, and regarded the "negative sensations" to which it leads as imaginary sensations, like the imaginary quantities in mathematics, or, in another aspect, as indicating the amount

by which the actual conditions come short of the zero point of sensation, or, again, somewhat as a bankrupt's debt might be considered as negative property. These letters, of which five (written in 1873–74) are given, aim to explain Fechner's conceptions, and to answer the objections raised by Preyer. Some incidental reference to Delbœuf is made in the second letter. The series is to be continued in the next number.

EXNER: *Das Verschwinden der Nachbilder bei Augenbewegungen.*— Motion of the eyes generally causes the disappearance of after-images and other subjective visual phenomena, and it is not hard to see why this should be so. The perception of subjective sensations is a hindrance in all normal vision, and we neglect them. Motion of the eyes enables us to do this, because subjective images move with the eyes, those of real things do not. We neglect subjective sensations, not consciously, but rather, says Exner, "by means of a central mechanism, which (not wholly unlike a reflex inhibition) catches away such sensations from consciousness without our assistance, indeed without our knowledge." To this explanation of Exner's, E. Fick and Gürber have objected, asserting, on the basis of experiment, that the disappearance of after-images on motion of the eyes, was due to retinal restoration depending on changes of circulation, which in turn depend on changes of intraocular pressure caused by the tension of the ocular muscles, closure of the lids, etc., etc. In reply, Exner urges that the disappearance of after-images is only a special instance of what happens with subjective visual phenomena in general, many of which are in no sense dependent on retinal fatigue and restoration. The well known usefulness of intermittent light in bringing out Purkinje's figures and the like, depends on its excluding motion, by which their subjective character would be revealed. The last traces of after-images can be discovered by rapid winking, which is just what should not happen, according to the restoration theory. For a similar reason, such things sometimes appear on taking a new fixation point, or at the instant of opening the eyes in the morning. Furthermore, movement of the eyes with the lids closed, or rhythmical pressure with the finger, do not cause the after-images to disappear. Disappearance might also be expected in the first of these cases on Exner's own theory—an apparent difficulty, which he explains by the absence of one-half of the ordinary basis of discrimination, to wit, the images of outer objects. A further proof of Exner's general thesis is drawn from the experience of microscopists, where, strangely enough, the exact opposite of the habits of normal vision is found. Microscopists are accustomed to move continually the object examined, and finally come to entirely neglect all images in the field that do not move, though the same are readily seen by those less accustomed to the use of the instrument.

AUBERT: *Die innerliche Sprache und ihr Verhalten zu den Sinneswahrnehmungen.*—Various complex motor processes are of vast importance to physiological psychology, and among them the motor processes of speech hold no minor place. It is with reference to these chiefly that this paper of Aubert's is written. He enumerates the factors of speech and their chief disturbances, in aphasia, agraphia, word-blindness, etc., notes the postulates made in common by the various schemata proposed for explanation, and finally comes to the question of how far the control of speech-motions by the sense organs is necessary. On this point he agrees with Stricker, that such control is not necessary, though he would not exclude it from all influence, as witness the first efforts of children in written speech, and the difference in one's own handwriting when the eyes are closed. In regard to the relation of the senses and the motor-image to muscular movements in general, he holds that the

admission of an innervation exactly graded to the amount of contraction of the muscle, and at the command of the motor-image, does not imply that the motorim pulse for an intended movement is therefore exact in extent, direction and time, in advance of practice, or that the extent of the intended movement is, in advance of practice, determining for space-perception as against a wrongly executed actual movement. The state of things may be quite different in respect to sensory control, when new movements are in process of learning, from what it is when they have become reflex through practice. Speaking and writing are learned at too early a stage for auto-observation, and most result is to be expected from the study of simpler movements.

LIPPS : *Ueber eine falsche Nachbildlokalisation und damit Zusammenhängendes.*—When one turns his eyes quickly from one object to another, *e. g.*, from one small flame to another, he can, if skillful enough, observe a transient strip of positive after-image which appears to shoot out from the first object, in a direction contrary to that in which the eyes move. [In trying the experiment, the reviewer finds it easier to get the phenomenon when the head and eyes are moved together; after the thing is once seen in this way, it can more easily be seen when the eyes alone are moved.] The after-image is falsely located, *i. e.*, appears on the wrong side of the object; and this view is supported by the fact that on quickly returning the eyes to their original position, a similar after-image is seen in the same place. Another feature of the experiment, however, was the first to impress Lipps, namely, that the first object seems itself to move in a direction contrary to the motion of the eyes. The two phenomena are closely related, and in explaining the second, the first is essentially explained. The author assumes, according to his theory of space-perception, (this experiment supports that theory in so far as it requires the assumption), that sensations of motion have nothing to do at first hand with visual perceptions of distance, though they may come to stand for them. Now, suppose the eye moves rapidly from a point *O* to a point *P*; the distance passed over in such a motion is *underestimated*, but at the same time the true distance from *O* of the advancing fixation-point is directly *perceived*, and the two united suggests a motion of *O* contrary to that of the eyes. But this suggestion is in contradiction with the immediate perception of the constancy of the distance between *O* and *P*; *O* must then appear again to return to its proper place. When the after-image is seen, its shooting out and return generally take the place of the apparent motion of the object, which is then assigned to a fixed place at the point from which the after-image appears to start. Such is the skeleton of Lipps's explanation ; for the evidence supporting several of the steps, and for the results of the experiment under altered conditions, as also for a brief series of objections to the theory of the immediate perception of space by motion of the eye, the reader is referred to the original.

SCHUMANN : *Ueber das Gedächtnis für Komplexe regelmässig aufeinander folgender, gleicher Schalleindrücke.*—Dietze, Wundt's pupil, found, in experimenting on the ability to recognize the identity or difference of number in two successive groups of metronome ticks, without resort to counting, (1) that the most accurate judgments were made when the ticks were given at the rate of 3—5 a second, (2) that there was an unconquerable tendency to break up the series of ticks into rhythmic measures, and (3) that the maximum number of ticks which could be compared depended on the measure into which they fell; if into 2's, 16, if into 8's, 40. Schumann has repeated these experiments, and finds a point of difference in result 2. His subjects were quite able to receive the ticks singly, though the breaking up of the series into measures

rendered comparison easier. Dietze's difficulty may have been either that a habit of receiving them rhythmically had been established, or that his ticks were not all alike in quality. The specific object of the repetition of the experiments was the study of the psychology of such comparisons. The method, according to Schumann's auto-observation (and in this most of his subjects agree), was something as follows. When a series of ticks is given, the subject usually accompanies each tick with some kind of muscular innervation, from which corresponding tensions result. When one standard group is frequently given, it and its number become impressed on the motor and sensory memory. In such a series each tick is expected and prepared for up to the last, and then the expectation and preparation cease involuntarily. Now, when the comparison series is given, the preparation goes on as before, and if the new series is shorter, the preparation outlasts it, if it is longer, the preparation stops too soon, and on this basis the subject makes his judgment. This preparation is influenced by several factors, but under favorable circumstances can be recognized after a very few experiments. One subject, who had been accustomed in astronomical observations to count seconds in groups of 10, could always indicate the tenth tick correctly. The results of Dietze fit in well enough with this explanation, but Wundt's assumption that the last member of such a series lies in the focus of consciousness, and the rest in more and more obscure regions, and that thus a means is offered for determining the *Umfang* or extent of consciousness for such impressions (implying that groups can only be compared when each can be taken into consciousness as a whole), is neither justified by Schumann's auto-observations, nor required by the facts.

Succeeding numbers of this new journal will contain regular reviews of current literature in the fields which it covers, and to this end the sending of off-prints, monographs, etc., is requested. These may be sent either directly to the editors (Prof. Dr. H. Ebbinghaus, Berlin, W. 62, Schillstr. 10; Prof. Dr A. König, Berlin, N. W. 52, Flemmingstr. 1) or through the publisher, Leopold Voss, Hamburg. The yearly volume is to be made up of six numbers, at a subscription price of 15 marks per volume.   E. C. S.

The law recently enacted in New York, removing the insane from the county poor-houses to state asylums, deserves mention as a most substantial gain in the scientific treatment of the insane, and in practical ethics. In the poor-houses the insane were often treated like other paupers and sometimes not separated from them; they were without special medical treatment, exercise in the open air, work or amusement, sometimes inadequately fed and clothed, and often neglected and abused. That this state of things was a means of profit to the petty county officers, is abundantly shown by the three years of hard work required to force the law through the legislature. All credit is due to the State Charities Aid Association for this significant advance.

A case reported by F. Ziehl in the *Deutsch. med. Wochenschr.*, No. 17, 1889, is interesting for its bearings on the independence of the sensations of heat and cold. In consequence of an injury to the lower arm, a woman suffered, besides other sensory paralyses, a complete loss of sensibility to warmth in the area of the ulnar nerve. The sensibility to cold, though blunted (only temperatures of 6° R. or below were felt), was retained.

From a laborious examination of the pupils in two Berlin gymnasiums (including the lighting of the rooms, school seats, age, race, skull

formation, orbital index, refractive condition of eyes, acuteness of vision, time of in-door work, business of father, optical condition of parents, grandparents, and brothers and sisters). Kirchner draws conclusions in support of the present prevailing views of the origin of near-sightedness. The following are among the points made: Race has a small effect; Jewish pupils are somewhat more apt to be short-sighted than German pupils; among the latter the blonde than the brunette. Low orbits are more frequent with the near-sighted, but this the author looks upon rather as an effect than as a cause (in this opposing Stilling). Heredity is important, especially if both parents are short-sighted. But distinctly the most powerful influence is near work with intellectual strain, especially when performed on badly made seats and in poorly lighted rooms. (*Zeitschr. f. Hygiene,* vii, 3, p. 397)

To the Editor of the American Journal of Psychology:

Dear Sir:—May I ask for the publicity of your pages to aid me in procuring co-operation in a scientific investigation for which I am reponsible? I refer to the *Census of Hallucinations,* which was begun several years ago by the " Society for Psychical Research," and of which the International Congress of Experimental Psychology at Paris, last summer, assumed the future responsibility, naming a commitee in each country to carry on the work.

The object of the inquiry is twofold: 1st, to get a mass of facts about hallucinations which may serve as a basis for a scientific study of these phenomena; and 2d, to ascertain approximately the *proportion of persons* who have had such experiences. Until the average frequency of hallucinations in the community is known, it can never be decided whether the so-called " veridical " hallucinations (visions or other " warnings " of the death, etc., of people at a distance) which are so frequently reported, are accidental coincidences or something more.

Some 8,000 or more persons in England, France and the United States have already returned answers to the question which heads the census sheets, and which runs as follows:

" *Have you ever, when completely awake, had a vivid impression of seeing or being touched by a living being or inanimate object, or of hearing a voice; which impression, so far as you could discover, was not due to any external physical cause?* "

The " Congress " hopes that at its next meeting, in England in 1892, as many as 50,000 answers may have been collected. It is obvious that for the purely statistical inquiry, *the answer " No " is as important as the answer " Yes."*

I have been appointed to superintend the Census in America, and I most earnestly bespeak the co-operation of any among your readers who may be actively interested in the subject. It is clear that very many volunteer canvassers will be ｅeeded to secure success. Each census blank contains instructions to the collector and places for twenty-five names; and special blanks for the " Yes " cases are furnished in addition. I shall be most happy to supply these blanks to any one who will be good enough to make application for them to

<div align="right">Yours truly,</div>
<div align="right">Professor WM. JAMES,</div>
<div align="right">Harvard University, Cambridge, Mass.</div>